Note on a Fire-bulkhead.*

BY CHARLES M. ROLKER, NEW YORK CITY.

It is now three years ago that I wrote a paper on the fire which broke out in October, 1880, at the Chrysolite mine, Leadville, Colorado, of which I was at that time manager. The paper was read by title at the Harrisburg meeting in 1881, and was accompanied by plans and sections fully illustrating it. It was written to invite a general discussion of the course pursued in the management of that fire, since the various fragmentary and sometimes prejudiced or inaccurate newspaper accounts were not suitable to base judgment on. The paper I offered, gave the facts as they appeared in the contemporaneous record which I had kept. At that time, a difference of opinion had arisen with an adjoining mine, as to possible damages entailed through the fire; and a law suit was talked of. In view of these circumstances, the President of the Chrysolite Company advised a temporary withdrawal of my paper. Somewhat later, I withdrew it entirely, because of the unlooked-for delay in arranging the controversy referred to. It has now, indeed, been amicably settled; but the lapse of time has deprived the matter of much of its immediate professional interest. To the urgent request of some of the members, that I should, at least, give a description of the fire-and gas-proof bulkheads employed, I yield with some hesitation, since I lay no claim whatsoever to originality in these devices, and therefore question the value of such a paper. The fire originated by accident, in the Chrysolite, a mine comprising extensive and more or less irregular workings, containing immense quantities of timbering, but partially packed with waste rock or earth. This class of mines is numerously represented at Leadville, Colorado, at many points in Utah, at Eureka and Virginia City in Nevada, etc. Moreover, the Chrysolite is connected by underground workings, for more than a thousand feet east of the seat of the fire, with adjoining properties, which have numerous shafts. The neighboring mines are situated on higher ground, the hill rising in an easterly direction; but they are worked to practically the same underground level. The ore-deposits of Fryer Hill occur as shallow and more or less flat deposits. The deepest ore-occurrence in the Chrysolite was, at the time, one hundred and fifty feet below the collar of the main hoisting-shaft, and it varied from that, to 66 feet from the surface, where the only covering to the ore consisted of *detritus* and grass-roots. The ore-occurrence in the adjoining mines, was very similar, barring local synclinals and anticlinals. The felsite, where it overlies the ore, is finely fissured. In the Chrysolite, ore had been repeatedly mined up to the *detritus*, and it had been allowed to cave in, thus established more or less connection between the surface and the underground workings. Considering the rise of the hill to the east, and the fact that the fire started near the extreme west workings, at the foot Fryer Hill, it is apparent that an immediate joint action on the part of all the connected mines, was not alone desirable, but imperative, inorder to control the draft.

Unfortunately, we were not able to agree upon harmonious action. As a consequnce, the fire was eventually drawn over a stretch of 400 feet of stoped-out ground, in places 30 to 35 feet high, and averaging, probably, 15 to 18 feet in height, by 35 to 40 feet in width. The system of timbering in this mine is the square-set, Comstock style, varying, however, from that of the Comstock in having no diagonal members. Instead of these, the open square sets are filled with "cribbing," the sticks being 8- by 8-inch timbers; and according to the pressure and the importance of keeping the ground open, we employ solid cribs (each a solid mass of timbers) and open cribs (those in which space is left to fill in any waste that may be encountered). The stopes through through which the fire swept had some open sets, partly cribbed and filled solidly with waste; others, solidly cribbed; others, partly cribbed and but partially filled; and again, others, neither cribbed nor filled. The waste-filling of these timbered stopes was not a systematic one in any direction, but was the result of the local waste which was encountered in mining the ore. This made the approach to the fire, which, within the first few hours, communicated the flame to these cribs, extremely difficult, and even impossible, without a proper regulation of draft.

When it became apparent that harmonious action would not prevail, the necessity arose for the Chrysolite to isolate the best orebearing portions of the mine from the fire and from the adjoining mines, in such a way as to permit out extracting the ore; moreover, this had to be done promptly, since those parts of the mine were in imminent danger. I, then of course, abandoned the plan previously tried, of putting up temporary air stoppings, such as wooden doors (the cracks calked with cotton-waste soaked in tallow), plain earth-dams, etc. Readily constructed, permanent dams had to be built under sorely trying circumstances. Earth-dams packed wet and up to 10 feet thick, would let the carbonic acid gas through almost as though they did not exist. The stop-doors, calked by an old sailor, looked as if they were on fire, so rapidly did the smoke and gas work through the calk cracks. In places, on account of the carbonic acid gas and smoke which were drawn through by the eastern openings, men could work but five minutes at a time behind these temporary barricades, though they were supplied with fresh air by a No. 4½ Baker blower.

Dr. A. Serlo (*Bergbaukunde*, 3d edition, page 328) quotes from the *Berggeist*, and advises the covering of stoppings, on the side facing old works which generate gas, with a coating of asphaltum, to prevent the oozing through of gas.

The stoppings I adopted, were placed in gangways, drifts and winzes leading to stops, either on fire, or in imminent danger of fire but inaccessible, owing to the manner in which they had been filled and timbered. These stoppings consisted, first, of a temporary stop-door, introduced to weaken the current of smoke and gas. This was simply made of inch-boards, cut to proper lengths and nailed to the posts and caps of a drift-set, selected as near to the fire as circumstances would permit. The cracks were calked with cotton-waste soaked in tar. Behind this door, earth or clay was filled in solidly for say 4 feet, more or less, the drift-timbers being left in. It is well to moisten the earth or clay and beat it down. A plain board wall was nailed back of this tamped mass against another set of timbers, to keep it in place. This formed the complete temporary stopping, which aided by a bountiful supply of fresh air, was generally found a sufficient protection to permit the erection of the permanent stopping and bulkhead behind it. The latter was intended to prevent the spread of the fire itself, as well as the dissemination of gas and smoke throughout the remainder of the workings. To show the necessity of something more through and permanent, I may mention that a tamped earth-stopping, 10 feet long, proved insufficient, even at the distance of a thousand feet from the seat of the fire, to exclude the gas from a neighboring mine.

To effect a safe, permanent stopping, remove all drift-timbers for a distance of from 25 to 50 feet. This is done quickly, by cutting the posts nearly in two with an axe; cutting out or loosening the blocks and wedges, as far as this can be done; boring in the ends of the posts and caps auger-holes of the requisite number and size (according to the size of the timbers and the pressure upon them), to admit cartridges of giant-powder, to blast the timbers out. As many of the cartridges are fired simultaneously as the nature of the ground will allow. Mud-sills and all fragments of timbers are removed, and the now untimbered drift is filled in with waste or earth, the finer the better. It is well to wet the ground frequently in order to pack the fine waste and to keep the drifts cool. Whenever a sufficient length of drift has thus been freed from its timbers and has been filled in with waste, to insure the safety of the adjoining works, the final gas-bulkhead is put in. The length of the earth-dam is, of course, a matter of judgment, depending on the size and proximity of the stopes, as well before as behind the dam, and the combustible material in them; in other words, on the supposed intensity of the coming fire and the consequent likelihood of its spreading.

Preparatory to putting in the gas-bulkhead, the place in the drift where it is to be erected is trimmed down to a section as nearly rectangular as possible. If the time permits, it is best to cut into the sides of the drift, say, from 4 to 6 inches, so as to get a shoulder. In the bottom a similar channel is cut, which connects with the sides. Should a place be chosen as a site for the bulkhead where a drift-set has been standing, part of the bottom cutting and often some side-cutting can be utilized. In case no side-cutting is resorted to, the old mud-sill can be utilized, as a bottom-piece, after lagging its shoulders. The extended mud-sill or bottom-excavation is then partly filled with tar and the foundation or bottom piece of timber is laid in it. Proper care, must, of course, be exercised to lay the bottom-piece level, and to insure this, whatever piece of timber is used for it, its top and bottom should be dressed. On this bottom-piece a wall is built up, with such timbers as are at hand, dressed on two sides, I found 4 by 6 inches, or 6 by 6 inches of sawed sticks, a very convenient size. As the binding material for the wall, tar is used; and to give additional stability, each stick is spiked to the lower one The top-pieces are simply hammered in, but they have similar tar coatings; and the last one may require dressing and fitting underground. Holes, due to irregularities of walls or roof, can be filled in with clay or cement, if it is at hand. When the wall is completed, the entire face, clay and all, is covered with a thick coat of tar.

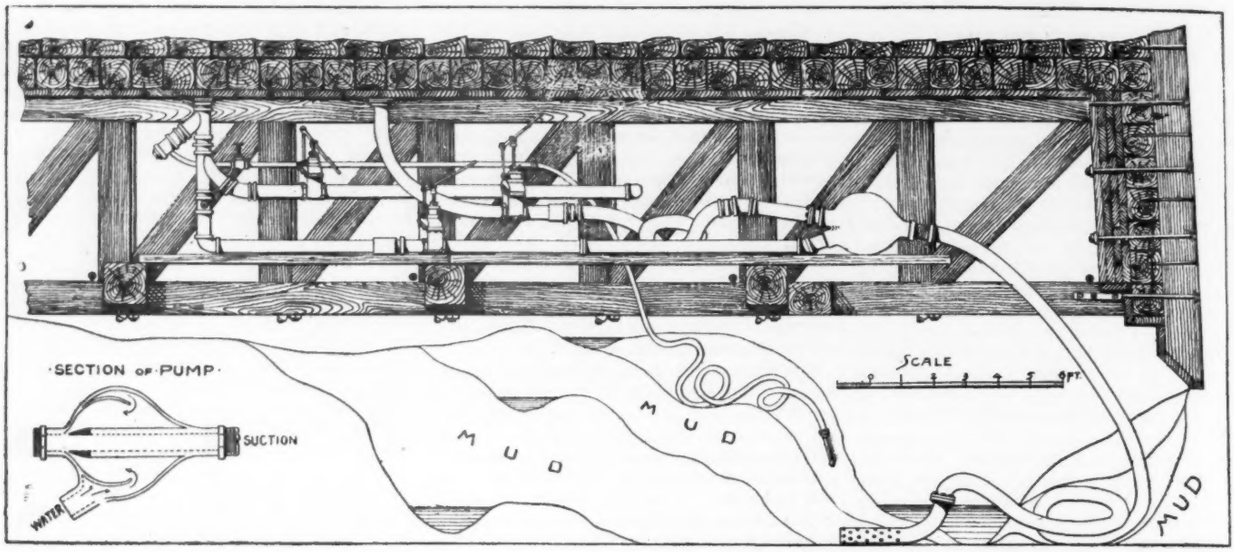
Instead of these wooden bulkheads, brick or stone walls may, of course, be built, and any little openings at the top or ends may be filled in with cement. But often, this material may not be on hand in sufficient quantities; or it may be much more expensive than the wooden bulkhead. Again, it will require longer time underground, to build a stone or brick wall, than such a wooden wall; and the wooden wall has the further advantage that nearly all pieces can be cut and prepared above ground, with plenty of elbow room and with as much dispatch as desired. Any good miner can prepare for, and build, such a wall, while he may not be able to lay a good brick or stone wall. The blacksmith shop can turn out the desired spikes.

I used eight of these bulkheads, with earth-dams from 25 to 50 feet long, free of timbers, and a temporary stopping in front of these; and in no case did any gas work through, or the fire spread beyond the temporary stopping. We mined for months behind the bulkheads, completely cut off from all connecting adjoining mines and from the fire, while neighbors, who resorted to other means, could not enter their mine on account of gas.

I may finally remark, that this fire was not

*From transactions of the American Institute of mining Engineers. Read at the Philadelphia Meeting, September, 1884.

FIG. 1.—HAVRE DE GRACE BRIDGE; ARRANGEMENT OF PIPES AND SAND PUMP.



put out in the beginning, hose in hand (with an upcast away from the attacking force and a downcast supplying the fresh air) because the fire originated, as indicated, in the west workings at the foot of Fryer Hill, while the connecting shafts stood east of it and on higher ground; these were not kept continuously sealed or were insufficiently sealed, so that they drew the smoke and gas east into the face of any attacking party. A southern shaft, on which a stack was built, was used as an upcast for a limited period. The mine was not flooded because the district did not supply water enough to flood.

Carbonic acid gas was not used to extinguish, the flames, because the Chrysolite itself could not be hermetically sealed, owing to the surface caves mentioned above, which had caused numerous cracks extending from the underground work to the surface. Again, the rock itself had numerous cracks and fissures in it, which, the deposit being a shallow one, would admit air and leak gas. Finally, the use of carbonic acid would have involved the filling with gas of all the connected adjoining mines.

Steam was injected in the hope of checking the flames, but, where used for this purpose, proved of little use except to cool the ground.

In the immediate neighborhood where the steam had been discharged, we afterwards found the lower part of the timbers not burnt but, the fire had burnt the top part and crept and spread along the roof.

The mine-shafts were closed up as tight as possible, by putting in scaffolding (for some, as much as 16 feet down the shafts) and packing dampened earth on top to stop air-currents and to confine to the mine, as much as possible, the carbonic acid gas was generated by the fire. The two last principles, combined and practiced, not alone by us, made the fire die out of itself, but not until seven months after we were working and extracting ore from our isolated portion of the mine.

Our experience showed that the heat retained in a smouldering stope, long after it had ceased to give signs of active combustion, was sufficient to cause a rekindling of the fire as soon as fresh air was admitted. Even when after the lapse of months, we cautiously penetrated into the burnt district, the heat of the ground was almost insupportable.

A Russian Railway Project.—The project is openly discussed to continue the Caspian and Askabad railroad to Sarakhs, Herat, Candahar, and the Indus river. Some say the object is to have a railway route from Russia to India. Military men believe that when the road is finished to Sarakhs, which will occupy three years, Russia will attack India.

Caisson-Sinking at the B. & O. Bridge, Havre de Grace, Md., (Caisson No. 9.)

Written for ENGINEERING NEWS.
BY COL. WM. M. PATTON, ENGINEER IN CHARGE.

(*Continued from page*, 262.)

Caisson No. 9 was commenced Jan. 2, 1884; concluded, June 14th, launching weight being 819,000 lbs.; towed into position, June 23rd, and last deck course completed, July 21st.

As this was a very large caisson, top dimensions being 76 feet 5 inches × 40 feet 6 inches, it was thought best to increase the strength of the deck, and consequently two additional courses of timber were placed upon it, making ten courses in all. In addition to this precaution stout braces were put in the working chamber to support the ends of the caisson; otherwise this caisson was practically similar to the plans published in ENGINEERING NEWS of Feb. 7, 1885.

The crib was commenced July 22nd, and the concreting on July 28th; previous to this, however, a paste of one part Portland cement and one part sand had been put on the deck to prevent leakage from the bottom into the crib, the sides of the latter being carefully caulked. This caulking proved ineffective, and drains had to be constructed following the sides of the crib and leading to wells from which the water was pumped; the aim was to keep the water from each layer of concrete for at least 24 hours after it was placed. On Aug. 30th the caisson rested on the bottom, 41 $\frac{33}{100}$ feet below low-water. The false bottom was removed by the 17th, and pumping out of the material commenced. In this caisson the blowing-out process was not resorted to, as the material could be removed more easily and rapidly by the pumps, two of which were used whenever practicable.

After the experience in Caisson No. 8, it was determined to limit the weight so as to always require a small reduction of the pressure to sink the caisson; the material was the same in each case, and by this method the delay, cost, and great inconvenience resulting from the use of blocking, was avoided. The weight was to be so adjusted that after cleaning out from under the cutting-edge, the bouyant effect of the compressed air and the friction on the sides would be sufficient to hold up the caisson, and ensure safety by leaving the material banking up under the cutting-edge, and enables the sinking to be controlled by supporting any desired portion of the caisson.

This work of excavating, concreting, (as weight was needed), and sinking went on in a satisfactory manner until the morning of Oct. 1st, when the cutting-edge of the caisson was 51 $\frac{37}{100}$ feet below low water. The weight of timber, iron and concrete was then 10,027,940 lbs., and the top of the crib was 2 feet below the water surface. A pressure due to this depth was consequently brought against the bottom of the coffer-dam, which was held by small pieces of timber spiked to the crib timbers; preparations were being made to put in the bottom set of bracing as necessary before any further sinking was attempted. But the sinking commenced before this was done, and the additional pressure brought upon the sides of the coffer-dam forced in one side of the dam, and the immense volume of water then pouring in, entirely wrecked that side and added 4,000,000 lbs. of extra load to that already on the caisson. Under this total load of 14,032,940 lbs., and with a reduced air pressure, the caisson rapidly settled into the yielding material below it a distance of 7 $\frac{17}{100}$ feet. The northwest corner struck the rock, the east side and south end careened and continued to settle until a large part of the roof of the working-chamber rested on the mud, and gave sufficient support to counter-balance the enormous weight. The air and supply pipes in the chamber were broken and, as a consequence, the air escaped rapidly, bringing mud and water with it; these pipes were, however, plugged upon the outside as soon as possible. The racking strains sprung a leak in the main shaft, which was partially stopped by the men inside the caisson at the time, by using portions of their clothing for this purpose: the men themselves, fortunately, escaped from the working chamber into the main shaft, where air was supplied to them in sufficient quantity by running both compressors at full speed.

The top of the main and supply shafts being submerged and the upper door of the air-lock open, this lock, 15 feet long and 4 feet in diameter, was filled with water. Fortunately the men below *could not* open the lower door, otherwise being ignorant of the cause and nature of the accident they would naturally have attempted to come out, and in such case would have been certainly drowned by the inrushing water. The volume of air escaping about the main shaft caused a great disturbance in the water surface at that point; and notwithstanding the fact that the top of this shaft was only 9 inches beneath the water, this boiling up of the water increased this depth materially and produced such a rapid current that any attempt at pumping or bailing was useless until the water could be controlled. Planks were first put around the shaft

vertically, with their upper ends spiked to timbers above, and the lower ends hanging free in the water; a tarpaulin was then wrapped around these planks drawing them close to the shaft, and this device had the effect of keeping the water comparatively still in the enclosed space. A paste of Portland cement was then put into bags, and a dam formed of these was built around the upper door of the air-lock; oakum dipped in cement grout was packed in between the bags and a perfectly tight dam was thus secured in a few minutes. The water was then as rapidly bailed out of the lock as the contracted space permitted, and about noon the seven men were rescued from their perilous position after being confined in the shaft six or eight hours. Although the frequent signals from above were answered, showing that some if not all the men below were alive, no information could be conveyed to them of the nature of the accident or the time necessary for their rescue; the feelings of the poor fellows can be better imagined than described, imprisoned as they were in an iron cylinder 4 feet in diameter, and the water slowly but surely rising upon them from below.

Nothing further could be done in sinking Caisson No. 9 until the coffer-dam was repaired. Upon consultation it was determined to sink a new side framed in every respect as was the old one, and to spike to the bottom of this, a layer of raw cotton wrapped in canvas and so placed that when the new side rested on the crib, this padding would take the place of caulking and make a water-tight joint. All this was successfully accomplished. This work was commenced on October 4th, and finished on October 11th. The vertical iron rods were tightened and pumping-out commenced on October 13th; this pumping had to be done slowly and cautiously. A full set of bracing was framed floating, and allowed to sink as the water was pumped down and was thus always in place to give support, should there be any signs of yielding in the sides of the dam. When the water was pumped down to within 3 feet of the top of crib, this set of bracing was wedged tightly in place and the pumping continued. It was now found that the south end of the coffer-dam had also been pressed in about 9 inches, and braces had to be inserted to stiffen this point; a top set was finally framed and the water pumped out entirely.

The repairs on the coffer-dam were executed with great skill and care by Mr. George Thomas, superintendent of framing and timber-work. Excavation, or cleaning out, to reach the broken pipes was commenced on Oct. 20th; the caisson was levelled by Oct. 26th, and the work of sinking and pumping out was proceeded with regularly on Nov. 12th. During this time the progress was slow, as the rock at the north end had to be blasted; the depth cut into the rock was 6 feet 3 inches. Dynamite cartridges were mainly used in blasting, as it was found that with care and due judgement this explosive could be used without any damage to the caisson.

Guided by the experience gained in Caissons 4 and 8, it was determined to stop sinking the caisson and to carry the excavation below the cutting-edge. The greatest depth to the rock below the bottom of the caisson was 13 feet, but, both to save time and insure good work, the concreting in sections, as in Caisson No. 8, was not attempted; instead of this the plan of building a wall of concrete all around the caisson was adopted, this latter method giving a good support and insuring against any mishap from escape of air and caving as before; the interior was then to be cleaned out, after this wall was completed, and concreted. On commencing the work, a layer of sand was found 2 or 3 feet below the cutting-edge and it became impracticable to put in the concrete as in No. 8, and the excavation was carried down by frames and sheeting. Sheeting plank was spiked to the inside of the vertical posts after excavating down to the sand; horizontal frames 10 feet square were then placed against these and another section of sheeting plank was then driven between the two as the excavation progressed. This plan was continued to the rock practically and each section when excavated was filled with concrete until the encircling wall was completed. After this concreting was commenced in the crib again and completed about the same time as that in the air-chamber. The shaft-holes were filled by Dec. 18th.

In the manner thus described in this series of articles the sinking and filling of five pneumatic caissons, of unusually large size and sunk to great depths, was accomplished in one season; this progress was accompanied by the delays incident to such work, by the loss of nearly an entire working month by the accident at Caisson No. 9, and the very slow progress made at Caissons Nos. 4, 8 and 9 after the highest point of rock was reached. For rapidity of execution the writer knows of no other record equaling that of this bridge.

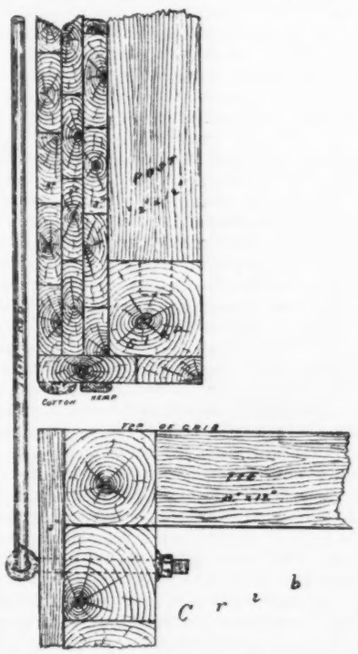


FIG. 2.—CAISSON NO. 9.

The only damage done to Caisson No. 9 when it came down hard on the rock at the north end, was the crushing of the bottom of the outside posts of the caisson, which crushing only extended a few feet; no bolts were sprung and the actual damage was not of sufficient importance to require any repairs.

Caissons Nos. 8 and 9 were in charge of Mr. R. C. Hollyday, assisted by Mr. W. L. Eissen; both of these gentlemen discharged the duties devolving upon them with firmness and good judgment, and the thoroughness of workmanship, both in the caisson and outside, bears witness to their conscientious and efficient services.

The plan Fig. 1 shows the arrangement of the pipes, pumps, etc., used in Caisson No. 9. Fig. 2 shows a section of the new side of the coffer-dam with the position of the cotton padding, the new side being represented as about resting on top of the crib.

DATA FOR CAISSON NO. 9.

Depth sunk below low-water	65	ft.
" " to lowest point of rock	78 3/8	"
Total excavation (no inflow)	231,691	cu. ft.
Timber in Caisson	465,125	ft. B. M.
" " Crib	203,824	" "
" " Coffer-dam	126,532	" "
Aggregate of all Timber	795,481	" "
Concrete in Cribs, Shaft, etc.	3,172	cu. yds.
" " Air-chamber	839	" "
" " below cutting edge	624	" "
Aggregate of all Concrete	4,635	" "
Barrels of Cement used in Concrete	4,027	cu. yds.
" " " " grouting	229	" "
Total barrels of cement	4,256	" "
Yield in Concrete per barrel of cement	1 1/100	" "
Average rate of sinking per day	0 3/10	" ft.
Iron Screw bolts	33,435	lbs.
" Drift "	59,245	"
" Spikes	11,237	"
" Cast washers	3,535	"
Total Iron used	107,452	"

RECAPITULATION OF TOTAL MATERIAL USED IN THE FIVE PNEUMATIC CAISSONS.

Total Timber in Caissons, Cribs, and Coffer-dam	2,727,755	ft. B. M.
Total Concrete in Cribs	10,930	cu. yds.
" " " Air chamber, and below cutting edge	4,036	" "
" " " foundation of Pier No. 5	211	" "
Aggregate of all Concrete	15,177	" "
Total excavation in sinking Caissons	816,384	cu. ft.
" Iron in Screw bolts	124,306	lbs.
" " " Drift "	216,028	"
" " " Spikes	44,650	"
" " " Cast washers	15,206	"
Aggregate of all Iron	400,190	"
Barrels of Portland Cement	10,620	"
" " Norton, Hoffman & Cumberland	3,668	"
Total barrels of Cement	14,288	"
Average of total yield of Concrete per barrel of cement	1 6/10	cu. yds.
Iron used per 1,000 ft. B. M. of timber	146 7/10	lbs.

Water Waste Prevention at Frankfort-on-Main, Germany.

Translated for Engineering News,
BY W. P. GERHARD, C. E.

W. H. Lindley Esq., M. Inst. C. E., Chief Engineer of the Frankfort on-Main Sewerage System, recently read a paper on "the prevention of waterwaste by means of the district water meter system," published in the *Journal fur Gasbeleuchtung und Wasserversorgung* (1885), from which we make the following abstract:

"While in some cities the compulsory introduction of water-meters into houses has stopped, to a large extent, the increasing waste, there are many other cities where the system of water-rates adopted, the small amount of water consumed in a single house, or other considerations, render the application of this remedy difficult, and where, consequently, the important question, how to meet the increasing demand, requires earnest attention.

In cities where water is pumped from a river, a lake, or a subterranean stream of ground water, the problem is usually solved by increasing the capacity of the pumping works. Such additional supply and the increase of the quantity of water available, undoubtedly offer advantages from a sanitary point of view. But, even in such cases it would be useless and extravagant to exceed certain limits. Moreover some towns require at all times a very economical management of the quantity available.

There are many cities, however, which are quite limited as to sources of supply, and where, just at the time of the maximum amount of consumption, a minimum quantity is usually available, as, for instance, when the supply is derived from springs. In all such cases an enlargement of the waterworks, to meet the increased consumption and large waste occuring during the hottest season, would mean a very large expenditure of money.

Under such circumstances, the engineer, should adopt other means, which, from a financial point of view, would appear to be more correct even in the first named instances, —namely, means tending to reduce the consumption of water to the lowest legitimate amount and to prevent all useless waste.

Applying these general remarks to the water supply of Frankfort-on-Main, we find that since many years the supply of water falls short of the demand; in summer time the deplorable remedy is applied of cutting off the supply at times, at first only during the night, but also during the afternoon, at such times when the yield of the springs diminishes and the consumption of water increases, in other words the system of supply is rendered *intermittent*. The sanitary objections—to say

nothing of the inconveniences arising in a city provided with sewers from the fact that during certain hours of the day the households are left without water, and water-closets and urinals remain unflushed, are too well-known and do not require any further consideration.

As a result, as might have been expected, it was seriously contemplated to increase the supply. Before doing so, however, it appeared to be necessary to examine first carefully into the amount actually used for household purposes, and into the quantity absolutely wasted. If an investigation would prove that the total amount of consumption was legitimate and useful, the only available and proper remedy would have been to increase the supply. Certain indications, however, pointed strongly towards the existence of a useless waste of water, hence the remedy appeared to be to carefully search for its causes and to remove them, if practicable. In other words, while all legitimate use of water tending to increase healthfullness, cleanliness and comfort, should be encouraged, the abuse, and above all, continued losses by leakage, or waste, should be prevented, without in any way inconveniencing the consumer, or causing sanitary objections. If an engineer succeeds in stopping and preventing all waste or abuse of water, he accomplishes the task of supplying a city at a minimum outlay for construction and maintenance of the works.

Suppose, for instance, he should succeed in reducing the legitimate consumption to one half the former total quantity—and it is feasible to attain such results, even in the case of otherwise well-managed works, as will be shown later—he renders the doubling of the capacity of the works unnecessary for many years to come, and manages to supply the city at only one-half the amount of expense. Such a result is important, not only in the case of cities supplied by pumping works, but also in the case of gravity supplies. The system of district water meters, which it is proposed to use at Frankfort-on-Maine, differs from that of house meters, although the latter partly effects similar results by a moral influence upon the consumers. The former system does not directly protect the city treasury by controling the amount of single consumers and requiring pay for all water wasted. It aims rather at protecting each citizen against the loss which he suffers, as a part of the whole community, on account of the waste arising from leakage in supply mains as well as in private service pipes, and which may amount to a large percentage of the total consumption. It, therefore, protects him against paying for water which runs away without being of any use, and which often causes positive injury.

But another important consideration should not be overlooked. Just now many German cities, which have adopted and carried out a system of sewerage for the removal of household wastes by water-carriage,—whether with or without the admission of faecal matter—are confronted by the important question, how to prevent the pollution of streams by the city sewage? A purification of the sewage is accordingly required, which, whether effected by irrigation or by precipitation or other means, is necessarily a costly and, sometimes, a very difficult undertaking. It is evident, that, wherever the total amount of the dry-weather flow of sewage can be reduced to one-half its quantity without causing injury to the healthfulness or cleanliness of a city, the cost for construction and management of sewage purification works may be correspondingly reduced.

In order to ascertain how far the consumption of water may be reduced without detriment it is well to find out first wherin the largest part of the water consumption consists. Right here let me define the character of the waste and leakage which the system of district water meters is intended to check.

This system does not deal with the overabundant and wilful consumption often occurring in private houses, but rather aims at ascertaining losses by leakage from loose joints, and from leaky and worn out faucets, which losses, as experience shows, amount to a much larger total quantity than losses from other causes. This appears often almost incredible to all those who have not investigated the subject. But, upon a more close examination it looks more probable since such losses are going on continuously, night and day, and simultaneously at many different places. Experiments and investigations have shown that even a slowly trickling faucet wastes about 7½ gallons per hour, while bibbs leaking more freely often waste as much as 250 gallons per hour. A single leakage amounting to, say 12.5 gallons per hour would suffice, if saved to double the quantity of water available in a single dwelling house, and smaller leaks, equivalent to the mere dribbling of a faucet are quite sufficient to double the amount supplied to the smallest consumers. Considering the vast extent of a distribution system, the thousands of pipe-joints, faucets and plumbing apparatus in houses, it becomes at once evident, how important a bearing such leakage has upon the total amount of consumption.

Well constructed water-meters must still continue to be useful in checking the aforesaid willful and unnecessary consumption of water, and since the amount of water drawn is rather large during a comparatively short space of time such water meters render efficient services in recording the quantity wasted. But, the losses occurring from leaky joints of service pipes, taps or fixtures are rarely registered by water meters, their hourly aggregate amount in one house remaining usually below the lowest amount recorded by meters. For only the most sensitive and delicate turbine water meter indicates correctly a consumption of 50 liters (13 gallons per hour.)

But, in addition to defects in the house service pipes and taps, district meters are intended to detect a large class of leaks, which could not be detected by house meters, namely defects in the street mains and at junctions of service pipes with the mains. It is a matter of common experience that in a permeable subsoil such leaks may continue for years, allowing very large amounts to be wasted without being detected.

It has been argued that an increased consumption and even waste of water may be of advantage to a city from a sanitary point of view, but such is not true, at least not to any noticeable extent. A continuous slight dribble at fixtures is unable to effect any flushing of waste pipes or drains, hence it is without any practical value, and ought to be stopped. It is true that if many such driblets are collected in a sewer the total amount of water wasted is considerable, and may do some good in flushing sewers. But, if it is really considered necessary to increase the flow in a sewer for the sake of flushing, it is better and cheaper to introduce into it cheaper water (*i. e.* water which need not be filtered, nor be pumped etc.,) which if discharged in a large volume at intervals will effect much more flushing, while consuming a much smaller total quantity."

Having thus forcibly stated the importance and necessity of providing means to stop the large and useless waste, Mr. Lindley describes in detail the district meter, invented by Geo. Deacon, Civil Engineer, at Liverpool. Most of our readers are already familiar with the construction and working of this apparatus, which has lately been given an extended trial in Boston.*

The apparatus was first tried at Frankfort-on-Main in two districts, one containing a large number of stores and also dwellings of the poorer population, the other a suburban district containing residences of the wealthier class of citizens. The results were as follows:

In the first named district the total consumption during 24 hours amounted to 237.4 cbm. (62,713 gallons), 69 cbm. (18,227 gallons) being lawfully used water, while 168 cbm., (44,380 gallons) or 7 cbm. (1,850 gallons) per hour was the amount lost by constant leakage. The population of this district is 1000 inhabitants, hence the total consumption per head per diem was 237 litres, (62.7 gallons) of which only 69 litres (18.3 gallons) were used, 168 (44.4 gallons) being wasted. In other words, *at least 70% of the total amount of water was utterly wasted.* A night inspection revealed in a single house at 1.20 A. M. a waste of 1.8 cbm. (475.5 gallons) per hour. After shutting off all house-connections a constant waste of 2 cbm. (528.3 gallons) per hour still remained, due to some leak in the street pipes, which was caused by a crack in the main. A subsequent house-inspection disclosed among other leaks a leaky ball-cock in a flushing cistern, which was stopped at night only to avoid the strong noise, by the owner closing the stop-cock at the branch supplying this cistern. This leak amounted to 1 cbm. (264 gallons) per hour, and its stoppage at night was clearly indicated on the diagram, by a sudden drop of the line about midnight. During the 18 hours of the day and evening there was consequently, an additional loss from leakage of 18 cbm. (4,755 gallons) increasing the total sum to 186 cbm. (49,135 gallons) per day.

The leaks of 1.8 cbm. in the house service, and of 2 cbm. per hour in the street main are equivalent each to from 40 to 50 cbm. (10,567–13,208 gallons) per day. In other words, the water wasted at a single leak would have been sufficient to supply 400 to 500 inhabitants. Two such leaks were found in one district, containinning only 1,000 inhabitants! After repairing the break in the street main, and after serving notices to the house-owners to repair the defects in the house services, another diagram was taken, which showed that the total consumption was reduced to 153.6 cbm, (4,057 gallons), the total waste from 186 litres per (49.1 gallons) head to 86.4 litres (22.8 gallons) per head, that is, nearly 50%.

The inspection of the second district gave similar results. With a total consumption of 180 litres (47.5 gallons) per head, 103 litres (27.2 gallons) were pure waste. These amounts were reduced to 138 litres (36.5 gallons) and 58.6 litres (15.5 gallons) per head respectively.

The preliminary trial of the system gave abundant proof of its importance to the city, and it is now proposed to introduce it for the whole city, which would require an expenditure of $8,750, besides an annual outlay of 2,500–3,000 dollars.

The system is expected to exert a great influence upon the character of the plumbing work and the quality of the fixtures used in the distribution of water in houses, such as valves, stop-cocks, ball-cocks, etc. The increased tendency, resulting from the contract system, to manufacture water pipe fittings of a lighter weight and consequently of less strength, and of an inferior construction, will hereby be largely counter-balanced.

*See paper by Mr. Dexter Brackett, C. E., in the Journal of the Association of Engineering Societies.

A SYMPATHETIC ink, for writing on postal cards, the *Paper World* states, is simply diluted sulphuric acid—one part, by measure, of acid to seven of water. When the ink is applied the card will at first show roughened traces of the writing, but after drying these disappear and the writing is as invisible as though done with water alone. Of course, only a gold pen or quill should be used with this acid ink. If it is desired to avoid the suspicion of sympathetic ink having been employed, the card may be written upon across the first writing with tinture of iodine, which will entirely fade out when heat is applied to develop the sympathetic ink.

ENGINEERING NEWS Three months for One Dollar.

Concrete Roofs and Roof Coverings.

BY ALEXANDER PAYNE.

In treating of concrete as a material for roof and roof coverings, it may be as well to limit the subject at once to those instances in which the employment of such a material would be of practical advantage. For the ordinary pitched roof of the general run of buildings we are not likely to see concrete much employed, except in the form of concrete tiles or slabs, on account of its great weight and the consequent expense of both the roof itself and its supports. We may also, I think, lay it down as a rule that concrete, if employed, would be not only used as a covering, but would itself form a part of the construction of the roof. The following appear to me to be cases in which concrete may be advantageouly employed in roofs. (1.) For flat roof; (2.) for all kinds of fire-proof roofs; (3) for all kinds of domes and vaults; (4) for the roofs of all buildings of a monumental character, in which great strength or durability is required.

As an example of the first kind, viz.: flat roofs, I may mention one which has come under my notice as district surveyor in my district. At Hackney, where Mr. H. M. Millar, builder, is erecting some small houses in which several ingenious applications of concrete are adopted, he forms part of the flat roof as follows:

1. The top story is covered by joists 8″ x 3″ at one end, and 3″ x 3″ at the other, made by cutting through an 11″ x 3″ joist diagonally, so as to get fall without waste, placed about twelve inches apart; these are covered by boarding in two-and-one-half inches widths, and three-fourths inches thick, each board being one-fourth inch distant from the next one (a very important point, as if laid close they swell with the wet, spring up and break the roof). On this as centring is added two inches of Portland cement concrete as a roof covering; the concrete is made of brick rubbish ground to powder in a mill, and with one-quarter in bulk of Portland cement added, thoroughly mixed dry, and then wetted and brought to the consistency of a thick paste. It is laid on the boarding, smoothed out with a trowel, and the roof is complete. A coat of tar is sometimes added, but it is not absolutely necessary. Mr. Millar says he has had about eight years' experience with roofs of this kind, has made about fifty, and has never had a failure except in the case of some which were done during a frost. More frequently the centring boards are put under the joists, embedding them, and thus making the joists practically fire-proof. I believe this is a method frequently adopted in the roofs of artisans' dwellings in the East End and elsewhere. It is quite obvious that in buildings of greater importance the same system might be adopted with iron joists instead of wood, or any of the numerous methods in use for the construction of fire-proof floors in concrete would come in also with slight variation as useful flat roofs, and no doubt many of the members present could give examples of such application.

2. The same reasons that make concrete available for fire-proof floors make it also available for fire-proof roofs of all kinds. I may give an example on the black-board. Suppose a fire-proof roof be required, and it is determined to cover the building with a roof on the mansard principle. Let all the principals be formed of iron trusses, the front and back walls of the attic story being framed of suitable iron uprights, instead of the usual wooden quarterings, and let the common rafters be of iron; put boarding on each side of these rafters, and quarterings to form a mould, and fill in with fire-proof concrete, so arranged as to cover and protect the iron, and you then have a complete fire-proof roof without thrust on the walls, which is neutralized by the trusses. I have noticed in houses in the course of construction in Paris, that all the roof framing and common rafters are frequently of iron, and it would be interesting if our secretary or some other gentleman equally well acquainted with French construction could tell us in the discussion if this iron framework ever has a concrete filling-in like the fire-proof floors which are so general in Paris; and also some member may possibly be able to inform us if this mode of construction has been adopted in America.

3. On the subject of domes and vaults I think I have little to add to what I have already said in the former papers above alluded to, so that I will not take up the time of the meeting by going into it, except to allude to the immense importance of the subject, and its bearing upon the whole question of style and construction in architecture. To realize this, one has only to turn to a work like M. Viollet-le-Duc's dictionary, and glance at the chapter on vaults in the article on construction, where he shows in that lucid analytical style which is peculiarly his own, how the whole fabric of the Gothic cathedral rose up step by step from the repeated attempts, after many failures, to cover in those large buildings in a fire-proof manner with stone vaulting. We know how the Gothic architects ultimately succeeded by an ingenious collection of the various thrusts of the vaults in given points, and opposing these by buttresses. Wonderfully ingenious and skillful as this method is, I think it must be admitted that it carries with it the elements of unrest, and comparatively early dissolution. In most instances, if one pier on one buttress gives way, the rest will follow at no distant date, like houses built of cards. It is to be doubted if buildings on this system, unless constantly watched and repaired, will ever attain the ages of those of Egypt and Greece, constructed on the principle of the upright support and horizontal lintel; and is it not quite possible that if the ingenious and practical designers of the Middle Age had had at their disposal iron in large bulk, worked with the ease and facility that it is in modern times, and a strong and plastic material like Portland cement concrete to use in conjunction with it, that the problem of roofing-in large buildings in a fire-proof manner might have taken a totally different direction to the buttress system of equilibrium between thrusts and dead weight, which so characterizes Gothic vaulted buildings?

I am now trenching on my fourth heading, viz: the suitability of the employment of concrete for roofs of buildings of a monumental character, where durability and fire-proof construction are required, and in proof of this I think I need only to refer to the examples of splendid buildings erected in India, both in ancient and modern times, some of which have been described and illustrated in the *Transactions* of the Institute, and in which concrete figures certainly as the chief material in the construction both of roofs, vaults and domes.—*British Architect.*

IT is a curious fact that one of the most famous poems in our language appeared originally in a magazine that seldom touches poetry at all, and the same periodical, after an interval of sixty-six years, now brings out another poem very similar in theme. Bryant's "Thanatopsis" was first printed in the *North American Review* for September, 1817. The May number of the Review, just out, has a poem by Robert Buchanan on "The New Buddha." The critics found fault with Mr. Bryant's poem on the ground that it was un-Christian: it remains to be seen what they will say of Mr. Buchanan's. The question, "Has Christianity Benefited Woman?" is ably discussed in this number by Mrs. Elizabeth Cady Stanton and Bishop J. L. Spalding. President J. L. Pickard writes on "Why Crime is Increasing," and David Dudley Field on "Industrial Co-operation," while Prof. Andrew F. West, of Princeton, contributes an article of great clearness and strength on "What is Academic Freedom?" James Payn, the English novelist, discusses "Success in Fiction, and T. F. Thiselton Dyer, "Superstition in English Life." The new department of Comments keeps well up to the standard with which it started

Blizzard Tossed.

[Lines from the daily life of a country agent on the Manitoba.]

6 A. M.—*After Moore—more work.*

In dreams he is back in the land of the south;
No snow flakes around him are falling,
But he hears a loud voice and awakes from his sleep,
'Tis the way freight conductor that's calling.

7 A. M.

After Longfellow—also after the switch lights.

There's a Minnesota blizzard breathing now,
Its mellow richness full of ice and sleet;
And from a breaker full of north pole cold
Pouring new frost bites on his aching feet.
He, on the railroad like a young snow bird,
Must trail his way to where the switch lights burn,
And grasping one in each half-frozen hand,
Back to the depot through the snow returns.

5 P. M.

Wild is the night, but a wilder night
In the agent's bosom pitches,
For again must he go through the beating snow,
To place the light on the switches.

Slowly and sadly he took the lamps
All covered with icicles hoary,
He walked but one mile, he froze but one toe
And left them alone in their glory.

11. P. M—*Worse than "Marco Bozarris."*

At midnight in his soft warm bed
The "plug" was dreaming of the hour,
When he, the knee no longer bent,
To corporation's power.
He awoke to hear the engine's bell,
He woke to hear the brakeman yell
"Get up! bring out your mail!"
He flew without a coat or vest
To put the mail on for the west,
He caught a fresh cold in his chest,
Alas! the mournful tale.

ANY TIME OF DAY! HOW TWO FORMER AGENTS MET.

A shape was flying through wind swept space,
Through shadow land, through no man's land;
It met another spectral face
And took it by the hand.

"How came you here?" the first one cried;
"Had earth no charms to keep
You there?" "Alas!" it sighed,
"I died for want of sleep."

"And you, too, died," the second said.
"For want of sweet repose?"
The spectre sadly shook its head,
"Not that, my friend, I froze."

(*Ex.*)

British Pratice in Boiler Construction.

Mr. D. S. Smart, in a paper recently presented to the British institution of civil engineers, describes recent British practice in steam-boiler construction. He states that 'low,' 'soft,' or 'mild' steel, which has the valuable qualities of iron without its defects, is now extensively used for this work. It is made usually from thirty to thirty-six per cent stronger than boiler-iron, and is superior, when well made, in ductility. Some variation in this last respect has led to considerable distrust of the metal; but this distrust has been quite often due to unfamiliarity, on the part of users, with the nature of the material, and with the proper methods of manipulating it. Some brands are found to weld like iron, while others will not weld, and are brittle. No accident of serious character has yet occurred, however, to any steel boiler, so far as reported. It is not yet fully ascertained to what extent deterioration may affect the safety of steel boilers. It is anticipated, however, that the metal is likely to prove more satisfactory in this respect than iron. Steel rivets are used to some extent, and their use is continually increasing. More care is requisite in their working than is demanded in the use of iron rivets. It is desirable that all parts of the boiler, and, as far as possible, of its appurtenances, should be made of steel, in order that voltaic action and consequent corrosion maybe avoided. Steel plates are usually drilled instead of being punched, as it is found that steel is more liable to injury by punching than iron.

ENGINEERING NEWS Three months for One Dollar.

"The Working Power of Man."

General M. C. Meigs, U. S. Army, retired, writes in the *Scientific American*, as follows: I have been puzzled by the very various figures given in engineer's and mechanical handbooks for the force or working power of man.

I think that, as compared with the standard English horse power, 33,000 foot pounds per minute, they vary from 1-5 to 1-11. The experiments quoted as those from which engineers and physicists have derived these various data disagree curiously in their products and in the deductions made from them by their authors.

It is difficult to estimate the work done with spade, shovel, axe or wheelbarrow. But there is one application or use of human strength which gives absolute and correct minute results which, it seems to me, should be exploited and published.

When a man or any human being ascends a stair of regular grade, he lifts his own weight. If he carries in his hand a watch with seconds hand, he can note the time occupied in the work of ascending one, two or three stories, and this height multiplied by his weight will give the absolute quantity of work done—foot pounds lifted—and this result divided by the time or parts of the minute will give the work per minute; dividing this again by 33,000 foot pounds, the work of one horse power per minute we will have a fraction of a horse power as the comparative measure of the man's work or force. If he ascends a tower stair until compelled to stop for breath, he will thus ascertain his extreme and ultimate force, power strength. If he ascends rapidly till exhausted he will accomplish in shorter time than when moving deliberately the work of which he is capable. Moving slowly, his effort will be longer continued, but he will in time reach a limit. By a series of experiments in this line by men of different forms, weights, ages and condition of health and training, very interesting results can be obtained for the physiological study of the human constitution. It would be interesting to determine the rate of increase and average of strength with advancing age, at what age a pound of flesh, blood and bone in a normal human being is capable of exerting the greatest force. Lately the following experiments were made:

A man of nearly 69 years of age, weighing 214 lbs., ascended a broad winding stair from first to second story of a house, height 14½ feet, weight raised 214 lbs., time 16 seconds, rate of work per minute 11,665 foot pounds; then the horse power during ¼ minute is at the rate of 0.353 H. P. Again, a man of the same age ascended two stories of the new Pension Building at Washington. This included 4 flights and the necessary landings; there are no winding stairs; weight 220 lbs., height 42¾ feet, time 74 seconds, work done per minute 7,627 foot pounds, horse power 0.231. Again, a man of about 69 years of age ascended to the third floor of the new Pension Building. First floor 20 feet, second 22.75 feet, time to 2d floor 29 seconds; to third floor 66 seconds; work done; 1st story, 4,400 foot lbs., rate per minute 9,109 lbs., H. P. 0.276. 2d to 3d, work done, 5,005 foot lbs., rate per minute 8,125 lbs., H. P. 0,2462. Whole ascent 42¾ feet, work done 9,405 foot lbs., rate per minute 8,550 lbs., H. P. 0.259. Another man, about 72 years of age, weighing 180 lbs., ascended another similar stair 42¾ feet in 63 seconds; work done per minute, foot lbs. 7,328, H. P. 0.222.

For a short time the first experiment shows a man of nearly 69 years putting forth without suffering an effort greater than ½ of a horse power; but when the effort was continued for about 1¼ minutes, the average result was rather less than ¼ horse power. The other (older) man developed during 1 minute or 63 seconds, a force 0.222 H. P., or rather less than ¼ horse power. Looking into details of these experiments we find that the man of 69 lightly clad put forth for ¼ minute a force of 0.353 H. P., ascending a height of only 14½ feet. Rather more heavily clad he put forth during ¼ minute the force of 0.258 H. P., and during the following ¾ minute of 0.218 H. P., the average during 74 seconds being 0.331 H. P. An older and lighter man exerted for 31 seconds, say ½ minute, the force of 0.2338 H. P., and for another half minute immediately following the first half, 0.2127 H. P.; average during 1 minute, or 63 seconds, the force of 0.222 H. P. Again the man of 69 years, with a heavy overcoat, weighed 222½ pounds. He ascended 20 feet by stairs in 15 seconds, work done 4,450 foot lbs., at the rate of 17,800 foot pounds per minute, which is an exertion of 0.54 H. P.—over ½ horse power. A younger man, 151 lbs. weight, ascended 61¾ feet in 49 seconds; work done, 9,324 foot pounds, at the rate of 11,417 foot lbs. per minute, equal to 0.346 H. P.

The Theory and Calculation of Earthwork Slopes.*

Written for ENGINEERING NEWS.

BY MANSFIELD MERRIMAN, M. AM. SOC. C. E.
Prof of Civil Engineering at Lehigh University.

Continued from Page 247.

15. TERRACES.—When terraces are to be constructed it is evident that the upper one may have the greatest slope and the lower one the least slope. Formula (22) may be used for this purpose since the area S need not necessarily be bounded by a curved line but may be disposed in any form desired.

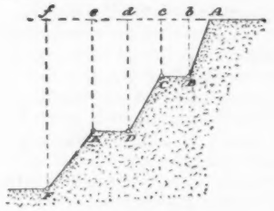


FIG 7.

For example take a bank 30 feet high in which it is desired to build three terraces, as in Fig. 7, with a factor of safety of 1.5. The height of each terrace is ten feet and there are two steps $B\,C$ and $D\,E$ each 4 feet wide. Let $w = 100$ pounds, $\varphi = 31°$ and $H = 5$ feet as found by experiments. Then $f = 0.6$ and $c = 71$ and formula (22) becomes

$$S = \frac{y}{108}\left(284 + 90\,y - 2\sqrt{139\,(90\,y + 142)}\right)$$

From this when $y = 10$, $S = 27$; when $y = 20$, $S = 159$, and when $y = 30$, $S = 421$. The abscissas Ab, cd, etc., are now easily found. Thus for the first area

$$\tfrac{1}{2}\,10\,Ab = 27 \text{ and } Ab = 5.4 \text{ feet}$$

The second area is that of $A\,B\,C\,D\,d\,A$, hence

$$27 + 10 \times 4 + \frac{10 + 20}{2}\,cd = 159, \text{ and}$$

$$cd = 6.1 \text{ feet}$$

The third area is that between Ff and the terraces, hence

$$159 + 10 \times 4 + \frac{10 + 20}{2}\,ef = 421, \text{ and}$$

$$ef = 8.9 \text{ feet}$$

The three slopes are hence as follows,

$$\text{For } A\,B, \cot.\,\theta = \frac{5.4}{10} \text{ and } \theta = 61\tfrac{1}{2}$$

$$\text{For } C\,D, \cot.\,\theta = \frac{6.1}{10} \text{ and } \theta = 58\tfrac{1}{2}$$

$$\text{For } E\,F, \cot.\,\theta = \frac{8.9}{10} \text{ and } \theta = 48\tfrac{1}{2}$$

To ensure the permancy of these slopes they should be protected from the weather by sodding.

(TO BE CONTINUED)

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The Buxton Sewage Works.

The new works for the treatment of the sewage of Buxton were opened on the 9th ult. They have been carried out on Dr. Thresh's system from plans by Mr. Joseph Hague, designed for the purpose of treating the town sewage by precipitation with iron water and lime, the iron water being conveyed by gravitation in specially-made earthenware tubes, with joints of jute, spun yarn, and cement, from a disused colliery at the foot of the Axe Edge hills. At a short distance from the "heading" entrance to the colliery, the iron water enters a brick receiving tank, constructed on the edge of the brook course nearest the colliery, and is conveyed across the brook in 9-inch metal pipes, supported on stone piers. A series of flushing chambers, supplied with penstocks, is introduced at suitable places along the route, which penstocks are furnished with convenient arrangements for charging the vans for street cleaning.

The liming and mixing-rooms are erected over the River Wye, supported by a stone semi-circular arch, the liming-room floor being on a level with the adjoining highway, and connected with the Board's sidings on the Midland Railway by an S curved tramway constructed with wrought-iron girders covered with creosote planking, supported by neat and substantially built rock-faced stone piers, with massive ashlar coigns, over which the lime required for precipitation purposes is conveyed from the sidings alluded to to the hopper entrance of the liming machine, which entrance is on a level with the floor, and connected with one of Messrs. Bowes, Scott, and Read's patent liming machines. A cistern of 800 gallons capacity receives the pulped lime from the machine, and is supplied with an agitating apparatus to keep the lime required during the night of a uniform and suitable consistency. Both the machine and agitating apparatus, etc., driven by an "over-shot" water wheel, 16 feet in diameter and 3 feet wide, the water for driving purposes being taken from the Wye, about 500 yards higher up the stream, and conveyed in large sanitary tubes.

Immediately outside the liming and machinery-rooms are constructed duplicate brick tanks, into which the main outlet sewer discharges. The tanks are furnished with wrought-iron screening wagons for the purpose of abstracting the solid and floating matter—estimated at 75 per cent. of the total sediment. The machinery for raising the wagons and lowering them into position consists of a "wrench," secured to metal framing, supported on metal columns. After passing through the screening wagons the sewage runs through a brick conduit into a circular metal chamber, furnished with horizontal paddles, where the iron, lime and sewage is thoroughly mixed. From here the sewage flows a distance of 50 yards through an earthenware conduit to the settling tanks, consisting of two sets so arranged as to work either singly or together. Those tanks are of convenient design, and are constructed of brick walls set in cement, with concrete bottoms, the walls being coped with neatly-dressed local grit stone. The length of the tanks is 266 feet by 73 feet, and are capable of holding 400,000 gallons. The formation of the tank bottom is of original design, being 3 feet 6 inches deeper at the entrance than at the outlet, an arrangement which has fully met the object for which it was introduced, that is to retain the sludge at the inlet end of the tanks. The first of those tanks is formed with a brick division wall 6 feet from the inlet, supported on arches of a similar material, under which the sewage flows into the second tank and thence through the entire series of tanks, with a barely perceptible motion, to the effluent weir sill, which, is of large ashlar tooled-dressed stone curved and bevelled on the front edge, over which the water flows on to the weir bottom, a depth of about 18 inches. The weir consists of courses of Lancashire stone dressed pitching set in cement, with a drip break joint of about ¾ inch, which gives a very pleasing appearance to the effluent, and exercises upon it a powerful oxidizing effect. From here the effluent is conducted in a serpentine course into the river, at a distance of about 30 yards below the tanks.

In the center of the main division-wall at the inlet end of the tanks a triangular well is constructed for cleansing purposes, and is supplied with duplicate iron run-off cloughs so arranged as to remove what water remains owing to the extra depth of the tanks at that end. After the suspended matter has subsided, outside the entrance tank is a sludge-well, fitted with strong chain pump, driven by water power, and with cloughs so arranged as to remove the entire of the sludge. It should be stated that the bottom of this tank is formed with a longitudinal and transverse inclination, with the view of expediting the cleansing process, rendering it thorough and minimising manual labor.

Dr. Thresh, in explaining the system, said he was without faith in sewage farming, and considered that chemical precipitation is the better plan. The iron water from a disused mine removes the matter, and especially with addition of lime. But sewage could be treated much more easily, were every householder to see after the sanitation of his own dwelling. It is much cheaper to make even a liberal use of disinfecting powder than to pay doctors' bills, and every loca

board should be compelled to provide a supply of some simple and cheap disinfectant for anyone willing to fetch and use it. For use on slop stones and in water-closets a crude ground sulphate of aluminia, which can be bought for about 50s. per ton, or say ¼d. per pound, mixed with a little carbolic acid, and perhaps lime, forms a splendid deodoriser and disinfectant, and sewage containing these disinfectants putrifies much less rapidly, and is more easily defected.

OUR MATHEMATICAL COLUMN.

THIS COLUMN was begun in No. 1 of the present volume, and appears regularly in the first number of each month.

NO METHOD has yet been discovered by which the three real roots of a cubic equation can be expressed by real and finite formulas.

THE LAST number of the *American Journal of Mathematics* contains an article entitled: Solution of Solvable irreducible quintic equations without the aid of a resolvent sextic. The general equation of the fifth degree is, however, not yet solved.

THE OLDEST mathematical work of which we have any knowledge is that called Kin-tschang, or the Nine Chapters of Computation. Its date is about 2600 B. C., and its author was Lischan, a cabinet officer of the Chinese Emperor Hwang-ti. The first of these chapters was devoted to geometry and surveying, and the others to arithmetical operations, mensuration, positive and negative quantities, ratios, the extraction of square and cube roots, and the solution of quadratic equations. For about three thousand years it was the standard mathematical text-book in the course of study for the Chinese princes.

PROBLEM 9.—Let $A\ B\ C$ be a triangle in which $C\ A\ B$ is obtuse. Let $A\ D$ be a line perpendicular to $A\ B$ drawn from A to a point D in the line $C\ B$. Given $A\ D = 25$, $A\ C = 30$, and $A\ B + B\ C = 100$. Required $A\ B$.

The following approximate solution is by Robert L. Buddell, Glenville, W. Va.:—Produce A B to E, making $A\ E$ equal to 100. Then in the original triangle $A\ B\ C$ the angle at B will be approximately twice the angle at E. As E is easily found from the triangle $D\ A\ E$, the value of B is thus known, and the other parts may then be computed.

The following exact solution is by N. Shiraishi, Philadelphia: Let $A\ B$ be called x, then $B\ D = \sqrt{x^2 + 25^2}$. Produce $B\ A$ and draw $C\ E$ perpendicular to $B\ A$ produced. Then from the similar triangles $B\ A\ D$ and $B\ E\ C$ we have

$$C\ E = \frac{25\ (100 - x)}{\sqrt{x^2 + 25^2}}$$

Now the area of the given triangle $A\ B\ C$ is

$$\text{Area} = \tfrac{1}{2}\ x.\ C\ E = \frac{25\ x\ (100 - x)}{2\sqrt{x^2 + 625}}$$

and the same area may be expressed in terms of its sides, thus

$$\text{Area} = \sqrt{65\ (65 - x)\ (65 - 30)\ (x - 35)}$$

By equating these two expressions for the area, and solving for x we have $x = 42\ \frac{1}{2}$ nearly.

PROBLEM 11.—If the earth is considered as a sphere, find the mean value of its radius from Clarke's values of the polar and equatorial diameters, namely,

Polar diameter = 41,710,242 feet,
Equatorial diameter = 41,852,124 feet.

The following solution is by S. Willett Hoag, Jr., New York:—Let d be the polar and D the equatorial diameter of the spheroid, and r the radius of the sphere. The solidity of the spheroid is,

$$S = \tfrac{1}{6}\ \pi\ d\ D^2$$

and the solidity of the sphere is

$$S = \tfrac{4}{3}\ \pi\ r^3$$

now, in order that the radius of the sphere shall be a mean of the radii of the spheroid, these two values of S must be equal, or

$$\tfrac{1}{6}\ \pi\ r^3 = \tfrac{1}{6}\ \pi\ d\ D^2$$

from which

$$r = \tfrac{1}{2}\sqrt[3]{d\ D^2}$$

By using seven-figure logarithms the value of the radius r is found to be 3958.785 statute miles.

In the same manner N. Shiraishi deduces 20,902,300 feet for the radius of the sphere.

THE PROBLEM to determine the most dangerous section of a rafter uniformly loaded has been answered by J. V. Hazen, Hanover, N. H., and by S. Willett Hoag, Jr., New York City, the former giving the position at 6.534 feet from the upper end, and the latter placing it 6.7 feet. The following letter contains a general discussion of the subject, and while we are pleased to print it in full, we would mention, like the engineering societies, that we are not, as a body, to be held responsible for the theories and opinions of contributors:

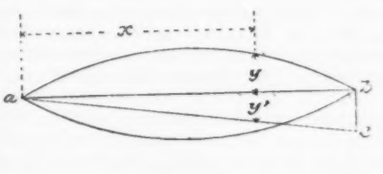
ALBANY, N. Y. April 15, 1885.

EDITOR ENGINEERING NEWS:—In your issues of March 7th, and April 4th, there appeared two problems relating to stresses in rafters, for which the following general solution is submitted.

Let l = length of rafter, h = height of peak above foot, s = horizontal span, all in inches, and w = vertical load per lineal inch of horizontal projection of rafter so that $w\ s$ = total load on rafter. Also let A = area of cross-section, I = moment of inertia about neutral axis and $d = \frac{1}{2}$ depth of rafter.

The load in the rafter is to be resolved at each point into two components, one parallel and the other perpendicular to the rafter. With respect to the parallel components the rafter is a column supporting a pressure which is zero at the top and increases at the uniform rate of $\frac{w\ h}{l}$ lbs. per inch until it becomes $w\ h$ at the foot. The pressure at the base of the columns is $\frac{w\ h}{A}$ lbs. per square inch. With respect to the perpendicular components the rafter is a beam supporting a uniformly distributed load of $\frac{w\ s}{2}$ lbs. per inch, or $w\ s$ lbs. in all. Under this load the maximum fibre stress at the middle of the rafter is $\frac{w\ s\ l}{8} \cdot \frac{d}{I}$ lbs. per square inch.

Now in the figure draw $a\ b$ horizontal to represent l. From b draw $b\ c$ vertical representing $\frac{w\ h}{A}$ and draw $a\ c$. Then any vertical ordinate from $a\ b$ to $a\ c$ will represent the compression per square inch in the corresponding section of the rafter due to the parallel components of w.



On the opposite side of $a\ b$ draw a parabola with its middle ordinate equal to $\frac{w\ s\ l}{8} \cdot \frac{d}{I}$. Then any ordinate to this parabola will represent the compression per square inch in the upper fibers of the rafter due to the perpendicular components of w. Hence the greatest compression will exist at that point where the sum of these two ordinates above and below $a\ b$ is a maximum. To find this point draw a tangent to the parabola parallel to $a\ c$. The point of contact will be the point through which the required ordinate will pass.

To determine this point trigonometrically, let y and y' be ordinates to the parabola and to $a\ c$ respectively at any distance x from a. The bending moment at x is $\left(\frac{w\ s\ x}{2} - \frac{w\ s}{l} \cdot \frac{x^2}{2}\right)$ inch pounds, hence the fiber stress at that point or $y = \left(\frac{w\ s\ x}{2} - \frac{w\ s}{l} \cdot \frac{x^2}{2}\right) \frac{d}{I}$ lbs. per square inch. And by the construction $y' = \frac{w\ h\ x}{A\ l}$.

Hence $y \quad y' = \frac{w\ s}{2} \cdot \frac{d}{I} \left(x - \frac{x^2}{l}\right) + \frac{w\ h}{A\ l}\ x \qquad (1)$

To find what value of x will make this expression a maximum, differentiate the equation, place the first differential coefficient equal to zero, and solve for x.

By so doing we find $x = \frac{l}{2} + \frac{d}{3} \cdot \frac{h}{s} \qquad (2)$

which gives the point at which the greatest compression exists, and, consequently the most dangerous section so far as failure by buckling is concerned.

But if the rafter is so braced by the purlins that it will fail by the tearing apart of the lower fibers instead of buckling, then in the figure, instead of drawing the parabola on the opposite side of $a\ b$ from $a\ c$, draw it on the same side and then the vertical intercepts between $a\ c$ and the parabola will represent the tensile stress per square inch in the lower fibers of the rafter. The greatest value of this intercept is at the point of contact of a tangent to the parabola drawn parallel to $a\ c$, and the distance of this point from a is where $y - y'$ is a maximum, which will be when $x = \frac{l}{2} - \frac{d}{3} \cdot \frac{h}{s} \qquad (3)$

By the aid of the equations thus established the problems referred to can be readily solved as follows:

Problem 10. A roof of 24 feet span and 5 feet rise consists of two rafters, each 6 inches deep and uniformly loaded. Find the most dangerous section of the rafter.

Here $h = 5$ feet $= 60$ inches, $s = 12$ feet $= 144$ inches, $d = 3$, and $l = \sqrt{5^2 + 12^2} = 13$ feet $= 156$ inches.

Substituting these values in equation (2) we find the most dangerous section to be $76\frac{7}{13}$ inches from the peak when the rafter fails by buckling. But if it gives way by tearing the lower fibers, then by equation (3) the most dangerous section will be $77\frac{7}{13}$ inches from the peak.

PROBLEM 8.—A roof whose span is 24 feet and whose rise is 5 feet consists of two rafters, each three inches wide and 6 inches deep. Find the load per lineal foot of rafter which will produce a compressive stress of 600 pounds per square inch at the most dangerous section of the rafter.

This can be solved by equation (1). The values of l, d, h, and s remain as before. Put $y + y' = 600$ $x = 78\frac{6}{13}$, $A = 18$ and $I = 54$. Substituting these values in equation (1) and solving for w, we get $w = 3.8054$.

Hence $w s = 547.9776$ pounds, and $\frac{547.9776}{13} = 42.1521$ pounds per foot of rafter.

CHAS. F. STOWELL.
Bridge Engineer, N. Y. State Board of R. R. Commissioners.

PROBLEMS FOR NEXT MONTH.

PROBLEM. 12.—(Proposed by J. Opperman, Buffalo, N. Y.) Take any triangle and upon each of its sides describe an equilateral triangle. Prove that the straight lines joining the centers of these so described equilateral triangles will form an equilateral triangle.

PROBLEM 13.—(Proposed by J. F. W., Jersey City) How many cubic yards are there in a rock cut 400 feet in length with vertical sides 27 feet apart; the cuts at the regular 100 feet stations being 5 feet, 33.5 feet, 43 feet, 33 feet, and 3 feet? The surface of the rock is fair and the cross-sections level.

PROBLEM 14.—(Proposed by A. S., Louisville, Ky.) What is the length of a strip of carpet three feet in width laid diagonally across a room which is 12 feet wide and 18 feet long? The carpet is to be laid in such a position as to allow the corners to touch the sides of the room.

PROBLEM 15.—A man bought 100 animals, consisting of sheep, lambs and pigs, for $100. For each sheep he paid $10, for each lamb $3, and for each pig 50 cents. How many of each kind did he purchase?

The Cost of Rails in Germany.

Dr. Wedding, in reviewing the iron and steel trade in Germany, discusses the capacity of the rail works of that country for competing with foreign rivals in the markets of the world. To illustrate the progress made in the reduction of cost he quotes the following figures as having been elicited in 1879 by a Government inquiry. Exclusive of interest and sinking fund, the cost of rails at different German works was as follows during that year:

Works.	Material Marks.	Wages. Marks.	General. Marks.	Total. Marks.
Koenigs-und Laura Huette	121.70	3.80	17.50	143.00
Union Dortmund	87.96	9.12	12.67	109.75
Bochum	85.85	9.43	25.64	122.00
Phœnix	114.54	7.90	3.56	126.00
Max Huette	123.20	10.40	6.40	140.00

At the same period, Dr. Wedding asserts, the cost at English works was not more than 120 to 125 marks, and in some cases only 102 marks. Now the cost at all of the German works has fallen to about 90 marks, while in the Cleveland district, England, they are 34.70 marks. Dr. Wedding attributes this relatively greater decline in the cost of manufacture in Germany to two causes. The duties introduced in 1879 put the German works into the position of holding the home market at fairly rumunerative prices, and to compete in the markets of the world at much lower figures. Formerly the reverse was the case, when Germany was a market open to all. Then the prices were lower there in proportion to the freights to point of delivery. In consequence of the certainty of a market, the production could be increased and general expenses were reduced. Another cause for the lowering of the cost of production was the introduction of many improvements in the technical details of manufacture.

THE Superintendent of the Toronto, Can., Waterworks, recommends the immediate purchase of five steel boilers, to cost $8,000; with mountings, brickwork and foundations, a total of $13,750. The present boiler plant is in very bad condition.

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FROM a recent statement by the librarian of the geographical society of Paris, it appears that the use of the metric system is now required by law in countries having a total population of 242 millions. Fourteen of these countries, with 207 millions of people are in Europe, six with 25 millions in South America, and one (Mexico) with 10 millions in North America. The system has also been legalized, but is not compulsory, in the United States, Canada, England. and Persia, whose total population is 98 millions. It is also stated that the system is considerably used without legal authorization in Uruguay, Venzuela, Egypt, Turkey, Russia and British India, whose population amounts to 333 millions.

In this country the metric system has made little headway during the past ten years, and, of course, there is no prospect that any legislation could be effected towards rendering it compulsory. Ten years ago it was thought probable that Congress might compel its adoption in all government business, but the efforts towards securing this end seem to have entirely ceased. All the colleges and technical schools require candidates for admission to be posted in the subject, while their courses of study almost entirely ignore it. It is now very unlikely that the use of the metric system in the United States will much increase during the next few years. A reaction seems to have set in.

Bradstreets', of April 25th, contains an extended article on the "West Shore Enterprise." In it the financial and executive management of this wrecked road is reviewed from its inception to date, and the exposè of peculiar relations existing between the parent company, the construction company and the numberless other "bleeders," is anything but complimentary to the manipulators of the road's finances. These relations are sufficiently intricate to require some pages of fine print to outline even, and a clear head and patience are required to unravel the mysteries of the deal. The article practically protests against the present plan for reorganization, the main features of which include the perpetuation in power of the parties who brought the concern to its present lamentable condition and the sacrifice of the first mortgage bond-holders.

WE regret to see by the Kansas City papers that there is a bitter war in progress between the enemies and friends of Mr. Wm. B. Knight, for three years or more the efficient engineer of that city. His foes charge official corruption, and Mr. Knight calls for an investigation which has not yet been accorded. We can well imagine from his past record that Mr. Knight has not been any too well regarded by a certain class of city contractors and officials who prosper by wrong-doing; and that they should prefer to have the office filled by a more pliable tool is very natural; hence we suppose this outcry.

Testing Machinery.

As an answer to a number of requests regarding testing machinery for cements, etc., we would refer our readers to the late priced catalogue of testing machines issued by Fairbanks & Co., of 84 Thomas Street New York. This catalogue is handsomely illustrated and contains data concerning all the machines, for this purpose, made by the company; from those of 1,000,000 lbs. capacity to the smaller machines used for cement tests, etc. In connection with the Testing Department of the Fairbank's Company suggestions are given concerning the size and form of the various test pieces forwarded and prices for making special tests of any material.

Pollution of Water Supplies.

For a number of years past the city of Boston has been endeavoring to obtain an injunction restraining the inhabitants of the Town of Natick, from discharging sewage into Pegan Brook a tributary of Lake Cochituate which is one of the sources of supply of the city.

The supreme Judicial Court of Mass., has just rendered a decision in the case granting an injunction. The plaintiff claimed a prescriptive right to discharge sewage into the brook, and that if the city desired to preserve the purity of the water, power was granted to the city to take land on each side of the brook and thus cut off any use either of it or of its waters, and that the water right could not be taken separately from the land.

The court ruled that the prescriptive right to foul the waters of a stream is included under the term "water rights," which "water rights" had been included in the original taking of the lake, and that it was not necessary for the city, to take land on the sides of the brook to extinguish any prescriptive right to foul the water of it. Acting upon this decision the Water Board are now issuing notices to all polluters of the water supplies to at once cease, and many of the interested parties are taking steps toward stopping the pollution.

England's Naval Armanent.

Engineering, of April 17, has an editorial headed "Is England to be caught napping?" The text of its remarks is taken from a late pamphlet by Mr. Jas. A. Longridge, the inventor of the wire construction of ordnance. The author refers directly to the expenditure which will have to be made to re-arm the Navy, and he gives the following figures:—„There are 47 ships actually afloat or ready for sea, carrying guns of over nine tons weight to an extent of 4640 tons. There are eight ships already launched and preparing for sea, carrying guns over nine tons weight to the extent of 1050 tons. There are seven ships, not yet launched, which will require 1416 tons of heavy guns. Hence in the next two years, to replace obsolete armament and to arm new ships, 7106 tons of heavy guns will be required. For new ships just laid down, 1200 tons will be required, and for coaling stations 1500 tons. Of smaller guns, that is under nine tons, we will require to replace obsolete armament to the extent of 6293 tons. The total of our requirement stands thus:

9806 tons of heavy guns.
6293 " " light guns."

The author in detailing what has been done to meet this demand, quotes Sir Thomas Brassey as an authority, and declares that at present England has no heavy guns afloat; that in 18 months it may hope to have 1306 tons ready, and 12 months later, 256 tons more, being a total of 1562 tons of heavy guns promised by September 1887, and leaving a deficit of 8244 tons. Of the lighter guns needed, he says there is a deficit of 5000 tons at the present moment. The cost of all these guns built on present models would be £2,200,000.

Mr. Longridge says that Woolwich can not furnish the guns needed unless supplemented by another gun factory at a cost of about £600,000. He further says that the type of gun now made at Woolwich is unsafe, cumbersome and deficient in power. He compares the 110-ton Elswick gun, with its five concentric coils, with an 80-ton gun on the author's principle of wire construction, and says that even a 60-ton gun of his make will throw a projectile of 1250 lbs. with a muzzle velocity of 2300 feet, and take a charge of 556 lbs. of powder; this at 2000 yards would pierce 37 inches of iron. As to expense, he says the 110-ton gun would cost £19,500, while an 80-ton wire gun could be made for £4000.

Mr. Longridge renews his old request that two or three guns be made on his design and tested for power and endurance, and he utterly repudiates the idea that the wire guns now being made at Woolwich are made on the true principle; he says they are only wasting money there and will simply throw discredit on the wire system. He concludes his pamphlet, however, by a tirade against the Ordnance Committee, in which he charges that the money now being spent on wire guns is "wasted," and that they are being built under the direction of a body "of men who are ignorant of its first principles."

Engineering regrets that Mr. Longridge should have thus referred to the Ordnance Committee, as his remarks cannot but militate against the chances of his system being tried. But the figures produced by the author in his pamphlet are terribly significant, and *Engineering* believes it is little short of madness to refuse such an offer as is now made by Mr. Longridge. "We are admittedly behindhand with our guns, and very little seems to be done in the way of mending matters."

English Street-Cleaning Items.

The London *Contract Journal*, of April 15, contains some notes relating to team-work extracted from a late report of Mr. T. DeCourcy Meade, engineer and surveyor to the Hornsey Local Board.

The original report contains, according to the *Journal*, a number of useful tables, of a kind not often met with, having especial reference to the work of horses used in street watering, scavenging, cleaning and dusting.

The cost of watering the streets of Hornsey through the five years, 1880-84 inclusive, per superficial yard of watered carriageway varied only from 0.5d. to 0.57d. in the first four years named; but, owing to the fine summer of 1884, it rose to 0.7d. in that year. The smallest number of working days was 147 in 1883, and this rose to 178 days in 1884. The actual number of horse-days per season varied from 856 to 1677, with a maximum number of 14 employed on any one day. Besides providing horses for use on whole days the con-

tractor was required to furnish horses for portions of days; and for providing horses, harness and driver whenever wanted, the contract price was 9s.6d. to 10s. for whole days, and 5s. 6d. to 6s. for half days.

With from 22 to 28½ miles of streets in 1881-85, the cost of cleaning per mile was £34 10s. 9d. in 1881, £40 14s. 3d. in 1882; and £33 7s. 6d. in 1884. The cost of cleaning, per superficial yard, ranged from 0.5d. to 0.61d. in the years 1881-85.

The disposal of the wet slops gave the greatest trouble. The author alludes to a process of washing the street refuse now in operation at Holloway. There are there three wash-mills, about 20 feet in diameter, worked alternately by a 12 horse-power engine. The quantity of slop, etc., washed per week is about 600 cubic yards, and the mills are said to be able to wash about 120 cubic yards in 24 hours, using, in so doing 36,000 gallons of water. This quantity gives a residue of about 20 to 25 cubic yards of clean sharp sand, which is used for road making or sold at 3s. per yard. The skimming and "sludge" are mixed with stable manure, or dust-bin refuse, passed through settling tanks and sold. The disposal of this slop, etc., formerly cost the vestry an average of 1s. per yard; by the washing process this was reduced to 2½d. per cubic y ar

The removal of dust in Hornsey for the five years, 1881-84 inclusive, averaged per house per annum 11.02d., this is much lower than in many other localities, though the quantity was about the same, viz.:—2½ cubic yards per house per annum. In 1879-80 the parish of St. Pancras paid £6,187 for moving 25,000 loads, an average of 4s. 11d. per load; and in St. Mary Parish this work averaged in cost 3s. 7d. per load.

Excavation Tables.

S. B. Fisher, C. E., of Pittsburg, Pa., has published a new table "Table of Cubic Yards in Lengths of 100 Feet." It is adapted to the calculation of earthwork by the method of averaging end areas. The areas given in the table range from 1 square foot to 1000 square feet with corresponding contents in cubic yards opposite each; a secondary contents column gives the quantity for the half foot. The table is plainly printed on card-board and is sold at 15 cents per copy by the author, whose address is Engineer's Office, Penna. Co., Pittsburg, Pa.

Fifth Annual Meeting of the American Water-works Association.

The opening session of the fifth annual meeting of the American Water-works Association was held at Young's Hotel, in Boston, Mass., on April 21, the New England Association holding their meeting in conjunction with the first named.

A business meeting of the New England association was held first, President George A. Ellis of Springfield in the chair. The only business of interest transacted was the election of the following to active membership: B. H. Howe, Bridgeport, Conn.; H. F. Whidden, South Abington; C. W. Seymour, Hingham; W. H. Barney, Milford; B. S. Babcock, Nashua, N. H.; J. C. Broatch, Middletown, Conn.; George A. Stacey, Marlboro; Col. J. T. Fanning, Manchester, N. H.; W. F. Codd, Nantucket; A. W. Inman, South Weymouth; Willard Keith, Dexter Brackett, Boston; H. F. Davis, Athol; S. C. Heald, Worcester; J. H. Caldwell, Mystic, water registrar; Albert B. Drake, New Bedford; Wilbur F. Leonard, Ashland; Desmond Fitsgerald, Boston; Chas. Fred Crehore, Newton; E. E. Martin, Framingham; Albert A. Haggett, Lowell; F. H. Parker, Burlington, Vt.

The following gentlemen and business organizations were elected associate members: D. B. Spooner, Boston; Robert Bampton, Chadwick Lead Works; B. C. Mudge, Boston; Jason Giles, Chapman Valve Manufacturing Company, Boston; Nelson Curtis, Curtis Regulator Company, Boston; John Cunningham, Cunningham Iron Works; Albert B. Franklin, Boston; Randolph Brandt, New York City; Jarvis Steam Engineering Company, National Tube Works, D. Goff Phipps, New Haven., Conn.; W. H. Marsh, New York City; Walworth Manufacturing Company, Asbestos Packing Company, Boston Lead Company, George Merriman & Co., Henry F. Jenks, Pawtucket; Waldo Bierheis, Pattan & Draper, Tenney & Goodwin, John T. Langford, E. Hurley Growing, Henry F. Jencks, Jenkins, Brothers, Ward & Curley, Peet Valve Co.

When the business was concluded the American Association met and were welcomed to Boston by Mayor O'Brien in a brief speceh. The Association then organized with Mr. L. H. Gardner, of New Orleans, La., in the chair.

The business transacted at this meeting was also the election of members, the following active members being elected: H. M. Newton, I. W. Davis, Frederick Eaton, F. L. Fuller, Charles A. Hayne, P. J. McConnell, J. H. McMinn, M. M. Moore, P. J. Nagle, Wingfield Nesbit, P. B. Perkins, A. H. Denman, John C. Chase, William B. Bull, George B. Suman, W. F. McClary, Moses Jay, Jr., W. F. Moore, J. H. Brown, L. S. Wills, Hiram Cotts, A. F. Noyes.

Associate members were also elected; Gordon, Maxwell Co. and the Michigan Pipe Company.

A total of about 100 members of both organizations were present.

About 2 P. M. the joint convention again met at Young's, and Secretary J. H. Decker read his report. According to this document 37 active and 4 associate members of the American Association were enrolled during the past year, and one had resigned and two died in the same period. After the report of the executive committee had been read and accepted, Mr. Peter Milne, Jr., of Brooklyn, N. Y., read a paper upon "Water-waste in its Different Phases." Mr. Milne remarked that waste was often attributed to lack of suitable regulations and means for enforcing them, but he thought that imperfect construction, poor material and improper location of pipes had more to do with it. He suggested that the Board of Health and the Water Board of cities should be empowered to make regulations governing the style and character of water-pipes introduced into buildings, with reference to the prevention of freezing. He submitted the results of some eighty tests with water meters, and discussed the evidence given by their records. Upon a question from the President concerning the Deacon water meter, Mr. Dexter Brackett, of the City Engineer's office of Boston, and the official having direct charge of the Deacon meter service in that city, gave some of the results of their careful and long extended experiments.

The programme for the afternoon included the reading of papers by Mr. E. H. Brown, of Syracuse, N. Y., Mr. W. C. Stripe and Mr. P. H. Linneen, but as none of these gentlemen were present the time was consumed in the general discussion of topics of interest.

At 7 P. M. the joint convention seated themselves in the banquet hall at Young's and commenced what the menu termed "the duty test." At the head of the table sat Mr. George A. Ellis, president of the New England Association, and with him His Excellency Governor Robinson; Mr. L. H. Gardner, of New Orleans, president of the American Water Works Association; Mayor O'Brien of Boston; Peter Milne, Jr, of Brooklyn; Hon. R. M. Pulsifer; Hon. J. Q. A. Brackett, speaker of the House of Representatives; Hon. Thomas A. Doyle, Mayor of Providence, R. I.; Colonel J. C. H. Wyman of Valley Falls; Colonel George L. Vose, president of the Boston Society of Civil Engineers; Colonel Albert A. Haggett of the Lowell Water Board; Desmond Fitzgerald, superintendent of the western division of the Boston water-works; William B. Sherman, secretary of Corliss Steam Engine Company of Providence; Elliot C. Clarke, construction engineer of Boston improved sewerage system; Hon. William A. Simmons, president of the Boston Water Board; Hon. C. W. Kingsley, president of the Cambridge Water Board; Senator Henry J. Wells, chairman of the State Legislative Committee on Water Supply; Hon. J. Wesley Kimball, Mayor of Newton; C. Olney Arnold of Pawtucket and E. W. Cate, president of the Newton Water Board.

After a sufficient time devoted to the discussion of the good things spread before them by "mine host," President Ellis made an address substantially as follows:—He referred to the three things of paramount importance to the city or town as its streets, water supply and drainage, in which the second plays a most important part. There are no public works in America which can compare in social influence and future possibilities with water-works, our health, comfort and convenience demand them, and the question to be studied and solved by meetings such as this is from whence, and how all this precious fluid is to be supplied to thirsty consumers. As the representative of the New England Association he bade the American Society a hearty welcome.

Mr. L. H. Gardner, President of the American Association, replied to Mr. Ellis, and referred in well expressed terms of compliment to the kindly relations existing between Boston and New Orleans. He had a wholesome respect for an association which puts New England against all America.

Gov. Robinson was next called upon, and reminded the gathering of experts that they had work to do near at home in investigating and improving the quality of the water supplied in Boston, Springfield and other New England cities.

Mayor O'Brien in his address reviewed the work done by Boston and summed up the money expended by its citizens in obtaining a sufficient water supply and an unexcelled sewerage, and proudly referred to the fact that with all this expenditure its limit of debt was being lowered.

Then followed short addresses by Peter Milne, Jr., of Brooklyn, N. Y.; Hon. William A. Simmons, president of the Boston Water Board; Hon. J. Q. A. Brackett, speaker of House of Representatives; Colonel Vose, president of Boston Society of Engineers; Colonel Albert A. Hagget, of Lowell Water Works; Mr. William B. Sherman of Providence; Senator Weld, chairman of the Senate committee on water supply; Colonel Almy of Pawtucket; Mr. D. Fitzgerald of Boston, and Mr. E. W. Cate, of Newton.

Wednesday's proceedings opened by the reading of reports of committees; the first being that on "Pumping Engines," and it was followed by a long discussion. The report on "Kalamein Pipe," led to the expression of a considerable difference of opinion on the part of the members present. Mr. J. M. Carson, one of the committee, had experimented with the pipe and reported unfavorably upon it; of the other members of the committee, one, Mr. Holden, wished to give the pipe a further test before signing. Mr. A. H. Howland rather favored the wrought-iron pipe.

At 8.30 A. M., some of the members visited the pipe yard of the Boston Water Works, and under the charge of Mr. Dexter Brackett, Assistant Engineer, examined the practical working of the Deacon waste detector and the Church stop-cock.

In the afternoon the discussion on Kalamein pipe was resumed and Mr. Converse, Asst.

Supt. of the National Tube Works at McKeesport, Pa., read statements from two prominent chemists on Kalamein, in which it was recommended for roofing and water pipes. On motion of Mr. A. H. Howland, the association disclaimed the parentage of a pamphlet containing a report on this pipe, and said to have been authorized by that body. A statistical report by J. G. Briggs, one of the committee, on "Tests of Steam Coals," was read by the Secretary.

A paper by Mr. Wm. Golden, of New Orleans, on "What is Duty?" was read, and discussed by Messrs. Ellis, Baldwin, Chase and others. "Cast-iron Pipes" was next presented, by A. H. Howland, who gave a summary of the dimensions used, and the pressures to which they were subjected under different circumstances. The author thought that European formula for the determination of these dimensions were better than our own.

"Difficulties encounterered with Plumbers," was the subject of a rather humorous paper by Mr. W. L. Cameron of Memphis, Tenn., in which he detailed the experience of the Memphis Water Co., in an encounter with the local plumbers. They refused an offer to do work at a schedule giving them 100 per cent profit, and when the company hired plumbers to do work at cost price, the local parties attempted to "cut rates" but only succeeded in ruining themselves.

The evening session was taken up with the reading of a paper by Mr. A. G. Moore, of Cincinnati, on "Rules Governing Duty Tests." The other two papers on "Railroad Water Supply" and "Annual Reports" were not produced.

On Thursday, the closing day of the Convention, the association met at 10 A. M., and, after the transaction of routine business, they voted to hold the next annual meeting at Denver, Col. Resolutions of thanks were adopted to the New England Association for the warm reception extended by them to the American Association.

The committee to nominate a list of officers for the ensuing year reported the following list, which was adopted: President, Peter Milne, Jr., of Brooklyn, N. Y.; Vice Presidents, George A Ellis, Springfield, Mass.; Edwin Darling, Pawtucket, R. I.; A. G. Moore, Cincinnati, O.; B. F. Jones, Kansas City, Mo.; W. J. Milner, Birmingham, Ala.; Secretary and Treasurer, J. H. Decker, Hannibal, Mo.

Shortly after 11 o'clock, the members of the American and the New England Water Works Associations left the North ferry, city side, by the ferryboat "Hugh O'Brien," on a visit to Deer Island and the improved sewerage works, by the courtesy of various officials of the city. The committee of the day consisted of Desmond Fitzgerald, superintendent of the western division, Boston water-works; Elliot C. Clarke, constructing engineer of the improved sewerage system, and Benjamin C. Mudge. As invited guests, members of the boards of directors of public institutions and East Boston ferries and of the committees on water and improved sewerage were present. Several members of the associations were accompanied by their wives.

At Deer Island the party was received by President Whiting of the board of directors, and was escorted to the institutions by the Island band. A tour of the institutions was made, and then the visitors assembled in the chapel, where half an hour was pleasantly spent in listening to the singing of the boys and girls. President Whiting made a short speech, and Judge Wells of Boston and Peter Milne' Jr., of Brooklyn briefly addressed the children.

Soon after 1 o'clock the visitors bade farewell to the island, and proceeded to Squantum. Lunch was served on board the ferry boat. An extensive examination of the engines, etc., at the pumping station, Squantum, was made, at the close of which the members of the two associations assembled on one side of the elaborate building and were photographed. A little over an hour was spent at this point. Moon Island, where the outfall reservoir is situated, was the place next visited, and after a brief stay there, a short trip round the harbor was made, Boston being reached just before dark. The improved sewerage works were of especial interest to the visitors, and numerous remarks of a congratulatory nature were made as to the result of this experiment of disposing of the sewage of Boston.

The Condition of Working Men in Germany, Italy, Spain and Russia.

A correspondent of the Philadelphia *Press* has been gathering statistics concerning the condition of the workingmen of the countries above named, and from his matter we gather the following items:—

In Germany the sum received for a very long day's work is barely sufficient to provide the laborer with the black bread, potatoes, beer and bad spirits for which the dole is usually expended. But their present lot is an improvement on the immediate past, though their vigorous military obligations engender a hatred to the government and drive them to emigration and socialism.

In Austria the condition is somewhat better, for, though the workman is poorly paid, badly fed and indifferently lodged, his needs are limited, and the friendliness and good will of his employer offset somewhat the low wages. In his general ignorance of better things, he is content as long as he has a few spare coins to spend upon music and beer.

The natural cheerfulness and the extreme simplicity of taste of the Italian workman afford a precious compensation for his exceedingly low wages. Italy is one of the worst paying countries in Europe, and in the southern provinces especially, long centuries of ignorance and oppression have perpetuated a moral and physical degradation almost unparalled in civilized lands. In central and northern Italy, a better climate, cheap food and a better moral and physical status enable the lower classes to live with relative happiness and content upon their very limited income.

The Spanish workman is like his neighbor the Italian, in ignorance, poverty, patience and frugality. Agriculture has been neglected since the days of the Moors, and outside of Catelonia there is no industry worth speaking of. The Spaniard in disposition has less subtleness, ardor, industry and practical good sense than the Italian, and he bears the impress of the three centuries of ferocious and grotesque despotism marking the reigns from Philip II. to Ferdinand VII. In even the most poverty stricken native of Spain, pride in a past rank makes him rebel against manual labor.

The Portuguese is more industrious than the Spanish workman, not less ignorant, as temperate and frugal, but works with more spirit and works never less than six days in a week and ten hours in the day, and is, in general, polite, intelligent and active.

The Russian workmen is ignorant, superstitious, patriotic to fanaticism, and, like the Spanish workman, rather indolent, and also like him in dwelling in squalor. By contrast the Spaniard is opinionated and fiery, while the Russian is in general gentle in manner. Not only is the Moujick naturally amiable, but his work is more laborious and he carries with him the stigma of servitude. Child-like, improvident, habitually weak and given to terrible fits of anger, he is also addicted to the use of strong spirits. While the Spanish workman is temperate and nomadic, the other is sedentary. Misery is the lot of the Russian workman; he is badly nourished in a climate which demands substantial food, and always badly lodged. There are no special laws in his favor; he is worked night and day.

The Scandinavian workman without receiving high pay is well cared for by his employer With food cheap, strong home ties, with the spirit of association well defined and increasing educational, provident and charitable institutions, he enjoys a relative degree of comfort. They are honest and orderly, but are much addicted to drink.

The Belgian is worked hard, is entirely unprotected by law, and the employment of women and children in the mines and about the iron works reflects injuriously upon his family life. He is poorly paid and badly fed, and his lodgings though generally decent are often unhealthy. Drunkeness also renders his life morally and physically wretched.

The Swiss, while living poorly and in a poor country, are nevertheless among the most happy workmen in Europe. The Switzer has strong moral qualities, is intelligently cared for by his employer and has native good sense and good will. He is patient, calm, laborious and receives a comparatively good education; he is a citizen of a free country and is passionately jealous of his rights.

The Tehauntepec Ship Railway.

We have learned from an authorative source that the following amendments have been made to the Tehauntepec Ship Railway concession, and that the Mexican Government has approved the same:—

First.—A guarantee by the Mexican Government of 5 per cent. for 15 years on $25,000,000 of the stock of the Ship Railway Co., to be paid in cash, or Mexican bonds, each year after the Ship Railway is in successful operation.

Second.—The right to go to one or more foreign Governments for a guarantee on the remaining $50,000,000 of stock; and the right also to give a rebate of 25 per cent. on the tolls of the commerce of the countries thus assisting. Also to give them a representation of $\frac{2}{5}$ in the Board of Direction; this rebate to be extended to Mexican commerce; the rebate to cover a period of 30 years.

Third.—The grant of 333,000 acres in addition to the 1,000,000 acres granted in the original concession, and the right to at once locate and set aside these lands.

Fourth.—The right to import, free of duty, and sell to vessels using the railway, all coal which may be required.

Fifth: The right to own and operate, free of all duties and taxes, a line of tow-boats.

Sixth: The right to collect tolls in gold, instead of Mexican currency; which gives an advantage of about 18 per cent.

PERSONAL.

JOHN E. CHENEY has been appointed First Assistant Engineer of Boston, Mass. He has long been connected with the office.

CHARLES G. WHEELER, late Chief Engineer of a proposed new railroad from New York to Omaha, died suddenly in Akron, O., about April 20th.

G. W. HOLDREDGE has been appointed general manager of the Burlington and Missouri River Railroad leased lines, with headquarters at Omaha.

W. B. RYDER has been appointed superintendent of transportation of the Kentucky Central railway in place of C. H. Hudson, resigned.

COUNT FERDINAND DE LESSEPS was formally made a member of the French Academy on April 23d. He made the shortest speech on record.

H. B. STONE has been appointed general manager of the roads owned and operated by and in the name of the Chicago, Burlington and Quincy Railroad Company east of the Missouri River, with headquarters at Chicago.

JOSEPH E. WALTZ was elected City Civil Engineer of Dayton, O., on April 21st. Among the work to be done under his direction this year, is the expenditure of $100,000, lately authorized by the Ohio Legislature, for enlarging and re-building the Park St. Ditch.

F. W. CRAM, general Eastern freight agent of the Maine Central railroad, has accepted the position of general manager of the New Brunswick railway, embracing 440 miles of road. Mr. Cram was superintendent of the European & North American railway previous to its consolidation with the Maine Central, and is a railrond man of much ability.

JOHN PAGE, JR., son of Mr. Page, Chief Engineer of canals, of Ottawa, Canada, died recently. The deceased graduated at the McGill University, and has been engaged on the surveys of the Beauharnois canal and the River St. Lawrence, and the Welland and Lachine canals. He was also on the surveys of the Canadian Pacific R. R., and at the time of death was resident engineer on the Cornwall canal enlargement.

ROBERT GILHAM, chief engineer and manager of the new cable street railway of Kansas city which is about to be opened, was dangerously hurt on April 23d. While an iron grip, weighing over 300 pounds, was being placed in position in one of the cars, it was allowed accidentally, to slip, and, falling a distance of two feet, struck Mr. Gilham, who was underneath the platform, on the head, fracturing his skull. The wound, though not necessarily fatal, is a serious one. Mr. Gilham has been one of the leading spirits in this enterprise, and also in the proposed elevated road between Kansas city and Wyandotte. He is a comparatively young man, and a member of a well-known family in Hackensack, N. J.

The "Complete Catalogue" just issued by the Ingersoll Rock Drill Co. has really more than commercial value; and while we have on more than one occassion referred to the manner in which this firm has made known the character of its machinery and the record of its working, this last edition well deserves its name of "Complete." In addition to a most elaborate, detailed and illustrated description of every article of drilling plants that might be required by the contractor, miner, quarryman or engineer, the catalogue contains a well written treatise on the use of compressed air as a motor; the advantage of dry air; comparative tests, with cards, for economy in air compressors; loss through heat in compressing air, etc.

The purpose of all publications of this kind being to make the interested public thoroughly acquainted with the machinery described, its adaptability to the purpose intended and its economic and practical value, the makers of this catalogue must be congratulated upon the very satisfactory manner in which they have carried out this purpose.

Engineers' Club of Philadelphia.

Record of Special Business Meeting, April 18, 1885.

Past President Rudolph Hering in the chair; 34 members and 4 visitors present.

The following resolution, offered by Prof L. M. Haupt, was unanimously adopted: That a committee be appointed to draft a Memorial to the Legislature in behalf of the proposed topographical survey of this State, and to report at the next meeting, The chair subsequently appointed, as this committee, Prof. L. M. Haupt, chairman, Messrs. C. E. Billin, T. M. Cleemann, Frederic Graff and President J. J. deKinder.

The following committee was appointed to prepare a Memorial for publication in our Proceedings of the late Col. James Worrall, member of the Club: Messrs. J. Simpson Africa, chairman, L. M. Haupt and A. E. Lehman.

A handsome framed engraving of the old Wernwag Bridge was presented to the club by Richard Osborne, Civil Engineer.

Mr. James F. Wood described the Sewerage Work now in progress at Atlantic City, N. J. The sewers are being laid, under contract, by Messrs. Robinson & Wallace, of New York, who expect to lay this year 600 feet of 24-inch pipe, 1260 feet of 20-inch and 4,000 feet of 15 inch with there 6-inch conections. The above will drain into a well 18 feet deep by 24 feet 6 inch diameter, this well will be covered with two double floors 6 feet apart, and ventilated by brick stack 50 feet high. The main sewer cuts the town in half, receiving the drainage from the long avenues on both sides. The sewerage is expected to be pumped out and carried over the marsh, somewhere, and utilized. They are laying the pipes with fall of 7 feet to the mile, and propose to flush them with city water. In laying the pipes they have to sheet pile both sides of the trench, which is 12 feet deep in some places, the piling put down by making quick-sand with city water and dropping them in. They having 3 inch rabbit so as to make joint. Pipe joints under water are made with composition of North Carolina tar, linseed oil and lime; the piles, after filling up, are pulled out with derrick capstan and an old horse.

Mr. Jones Wister presented a description of the Beaumont Rock Drill, which is said to bore a 7 feet 2-inch hole at the rate of from 42 to 120 feet per week; to be suited to all rocks, but the very hardest; and to avoid the leakage and foul air incident to the use of dynamite. The workings of the drill were discussed by several members. Mr. John Fernie, M. Inst. C. E., who was present as the guest of the club, at the request of the secretary, described the character of the rock formation in which this drill had been used.

The secretary presented a specimen of the work done by the Air Brush, which works upon the general principle of the atomizer, and by which shade effects on drawings are rapidly and permanently effected.

The balance of the evening was occupied in the continuation of the discussion of the condition of Chestnut St. Bridge, Philadelphia. It was opened by Dr. H. M. Chance, who gave the result of his examinations of the displacement of the railing, and was participated in by a number of members, but it appeared that no change of previously expressed opinions had taken place.

HOWARD MURPHY,
Secretary and Treasurer.

The Missouri Association of Surveyors and Civil Engineers.

The published proceedings of the Fourth Annual meeting of the above Association, held at Columbia, Mo., on June 3, 4, 5 and 6, 1884, have just been recieved. The list of members included at that time 81 surveyors, civil engineers and honorary members. The following papers were read at the meeting and published in the proceedings:—Private Surveys, by Henri Chomeau; Boundary Lines, fixed by Agreement, H. B. Babb; Relocating U. S. Corners by Testimony, by S. J. Carter; Iron Bridges, by A. J. Tullock; Registered Surveyors *vs*: Co. Surveyors, by J. Y. Powell; A Uniform Method of Recording Surveys, by G. W. Latimer; Design of a Highway Bridge, Combination Howe Truss, by E. E. Wall. Prof. T. J. Lowry, of Missouri University, is the Secretary of the Association.

Proceedings of the Engineers' Club of St. Louis.

The Club was called to order by President Moore, at the Mercantile Library, on April 15th, twenty-four members being present.

Moved by Mr. Ockerson that the Club hold their meetings at Washington University. This motion was laid over until next meeting.

Mr. Wm. W. Penney was proposed for membership by S. B. Russel and Thomas D. Miller.

Mr. H. W. Baker read a paper on "Steamboat Shafts." The paper limited itself to the discussion of the shafts upon stern-wheel towboats, which are the troublesome ones in regard to breakages, and by the analysis of quite numerous examples of these as found in present use, and also of those which have broken down in service showed the causes of failure to lie mainly in the insufficient sizes of shafts used and the uncertainty of obtaining a good uniform quality of material in large solid forgings.

The subject of hollow shafts was discussed at some length, and it was shown that with the same weight of shaft now used, a hollow shaft could be constructed that would be several times as strong as the solid shaft, and that with a saving of one-third in weight there would still be a gain of fifty per cent. in strength.

For a cheap hollow shaft a cast shaft was recommended, and letters from prominent steel founders, both in this country and England, were read showing the entire feasibility of their construction.

For a better, but more expensive shaft, was recommended one made of a well worked, high grade steel, forged by pressure on a mandrel, as is done with those of large ocean steamships, and whose immense superiority was clearly shown.

A general discussion followed.

THOS. D. MILLER, *Secretary.*

Liverpool Engineernig Society,

A meeting of this society was held April 15 at the Royal Institution, Colquitt street, Mr. W. E. Mills, president, in the chair. A paper, by Mr. Charles H. Darbishire, A. M. I. C. E., on "Quarrying and the Preparation of Setts," was read by the author. The paper commenced by pointing out that the term "quarry" meant, primarily the place where the stone was hewn and squared, whereas now it means the place where it is won from the rock, and not necessarily where it is squared. Attention was called to the fact that the dressing of stone, as far as is known at present, was probably one of the first accomplishments man possessed when the race became distinctly human, and that in every age quarrying stone and working it up to serve a useful, or even merely an ornamental purpose, has always been one of the leading industries. At the present day, when trafic has become concentrated into comparatively narrow streets of cities and towns, to the extent it has done, exceeding frequently 200,000 tons per yard width of street per annum, the preparation of stone for paving to meet the exigencies of the case is of the greatest importance. The quarry described is situated at Penmaenmawr. The system adopted was fully dealt with, the various duties of the different sets of men being carefully gone into. Examples of the tools in use were exhibited, and they appeared simple enough in themselves, but it was explained that the art lay in using them skilfully. The paper concluded with a brief comparison of the system practically in force throughout North Wales with that under which quarrying is carried on in the large quarries of England.

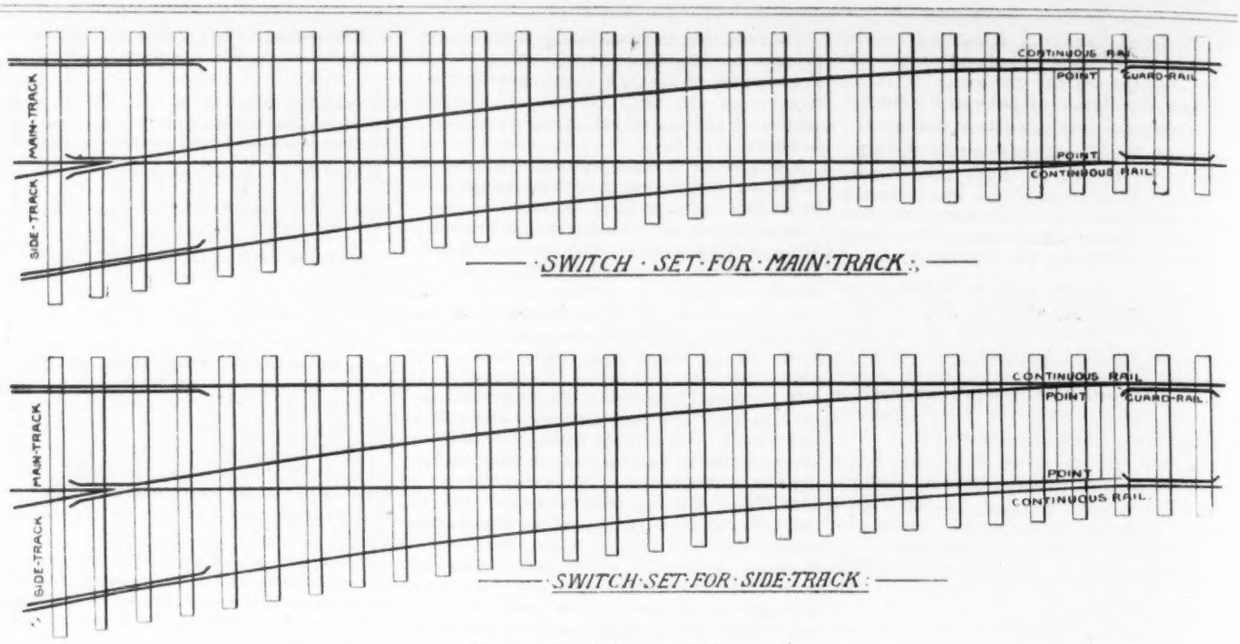

FIG. 81. SWITCHING BY "POINTS."

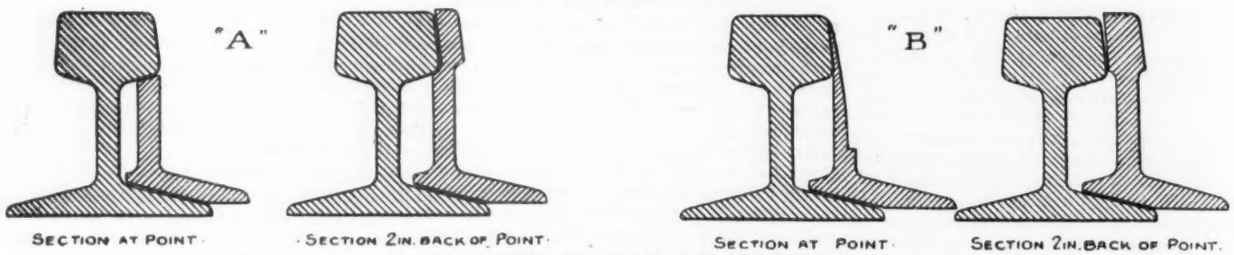

FIG. 82. TWO METHODS OF PLANING SWITCH "POINTS."

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 268*).

In general custom the word switch is used to designate the whole of the side track from the head block to the end. Properly the whole should be called the side track or siding; that special part from the headblock to the frog as the "turnout," etc.; the means or devise of passing from the main track to the side track as the "switch." In such sense I have used the three words and will so continue through these pages.

In what has gone before the "stub-switch" operating through moving rails, has been the only one described, as it more distinctly illustrates the general principle, and is in common use everywhere. The stub-switch, however, has two vital defects: first, it is not safe. If used as a trailing switch in case it is misplaced, derailment must ensue as the wheels drop off the ends of the rails, and carefully kept statistics, to which I have had access, show that of accidents resulting in derailment, 50 per cent. were caused by misplaced stub-switches. By actual figures the average cost, to track alone, of each derailment is nearly $6. This average includes not a single serious accident, and is made up entirely of small derailments of switching engines, etc., in large yards equipped with stub switches, and can safely be taken as the minimum damage to track alone by each misplacement, and in no way includes damage to rolling stock or delay to traffic. The extra cost of putting in a safety switch at those places where much work is done, is soon paid for. Even if a stub switch is set right the possibility of throwing a wheel from the track is still considerable. Should rod No. 1, or the connecting rod, break or wear loose, (as they do, and rapidly, too), the ends of the moving rails are not rigidly controlled so that a wheel with a sharp flange is liable to mount the end of the stub rail, and sometimes flanges are so sharp as to need only ¼ to ½ inch play of the moving rails. Second, the necessary gap between the ends of the moving rails and the stub rails cause a severe jar to the rolling stock. Into this gap, generally 2 inches, every wheel must drop battering the rails, jarring machinery and running gear, and creating considerable discomfort to passengers on account of noise and jolt.

In order to avoid this latter difficulty by affording an unbroken bearing, the "Split" or "Point" switch is devised, to which at the same time there is usually added some contrivance to allow the switch to be automatically thrown, in case it is misplaced, and so prevent derailment. It thus becomes a "Safety" switch. These safety switches are sub-divided according as the main track and turnout each have one rail continuous, or as both the main track rails are unbroken, and the wheel flanges are carried over them to the turnout.

The general principle of the first class is shown in Fig. 81, where the rail in the main track opposite the frog is continuous, while the other one is bent so as to pass unbroken to the side track, while the continuity is secured by a rail planed to a thin edge, lying close to the bent rail.. By a similar planed rail the transfer is made from the main track to the siding. These planed rails are called "Points," after the English term. When these points are controlled by the ordinary rigid switch stand their sole advantage is the removal of the jar, but by introducing a spring or other devise, gaining the same end, so that in case they are set against a train trailing out of a switch, the wheels will push the points to one side and continue on as if everything were right in the first place. It is therefore in the arrangement of this spring that the principal differences in the various safety switches lie for with few exceptions, the only special details about the points themselves are in the degree of the excellence of the manufacture or ingenuity of the methods of connecting the tie bars.

The chief difference is the varied practice of manufacturers in planing the points according to one of the modes in Fig. 82. In *A* the inside of the head is not planed parallel to the web, but at an angle so that the planing on the outside entirely cuts away the head at the toe, and the point fits under the head of the main or "stock rail." In method *B* the inside of the head is planed away flush with the web, and the outside of the head is removed to give the shape shown.

The sections of both styles about 2 feet back from the point show clearly the principles and how the head is formed. It is claimed by adherents of *A* that with *B* the end of the point presents a surface for wheels to strike and perhaps to mount, but this however can be easily prevented by using guard rails. On the other hand it is urged against the system *A* that the strength of the point is sacrificed both by the thinness and the bearing not being directly over the web. In all cases as the point recedes from the toe the head should gradually regain its full height so that the point rail resting on the flange of the main rail the head of the former will project above that of the latter and carry the wheel. This prevents hollow ties from cutting the main rail.

TO BE CONTINUED.

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THE DURABILITY OF MAPLE.—According to the *Building News*, manufacturers of wood mosaic say that they have found by experiment that hard maple on end is from four to five times as durable as marble and equally as durable as the hardest baked tile. It is reported that two end-wood floors were laid in the elevators of a public building in Chicago about fifteen months ago, and that the floors are in as good condition as when first laid, although each elevator carries from 1,000 to 2,000 people daily.

CORRESPONDENCE.

Unique Description of Land Boundaries.

CHARLESTON, FLORIDA & WESTERN R. R. Co.
SAVANNAH, GA., April 22, 1885.

EDITOR ENGINEERING NEWS.—Sometime since you published several unique descriptions of land boundaries, but I think the following from Florida deserves a place. "Commencing at a notch on one of the crossties on the railroad where the wagon road from the mill crosses the same, thence along the railroad in the direction of Fernandina 207 feet thence at right angles with the railroad. 414 feet thence parallel with the first line 207 feet, thence at right angles 414 feet to the place of beginning, being in all two acres of land."

SUBSCRIBER.

LITERATURE.

Journal of the Association of Engineering Societies, April, 1885.

CONTENTS.—Description of the foundation placed beneath the Pumps and Engines at Newton, Mass. Pumping Station; by Albert F. Noyes. Some New Sewer Formulæ, by Frank Hartford. Street Pavements in St. Louis; by Thos. H. Mackland. Treatment of Wood for Street Pavements; by Thos. J. Caldwell and Thos. D. Miller. Hydraulic Engineering in the Soudan; by Howard Constable.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(CONTINUED FROM PAGE 254).

DCCXXXIX—HACKENSACK, N. J.

Hackensack, New Jersey, in lat. 40°, 53′, N., long. 74°, 03′ W., the county seat of Bergen Co.; is on the Hackensack River. Settled in 1642, it was incorporated a village in 1868. Water-works were built in 1873, by a private company, after plans of John F. Ward, C. E., taking the supply from the Hackensack River. The pumping station, then built, has been abandoned. The present works were completed in 1882. The water is impounded at a point five miles above the village by a dam 6 feet in height, forming a storage reservoir which receives the drainage of 100 square miles. At this reservoir are placed two Worthington steam pumps of 3,000,000 gallons daily capacity each, which deliver the water through a 20-inch cast-iron force main 15 miles long, supplying the towns of Hackensack, Hoboken, West Hoboken and Union Town, New Jersey, the works at all of which places are operated by the same company.

At Hackensack a branch from this force main connects it with a reservoir constructed in embankment holding 3,000,000 gallons at 75 feet above the village. The water is conducted to the village by two miles of 12-inch cast-iron pipe, and distributed by 3¾ miles of cast-iron pipe of 12 to 4 inch diameter, with 47 fire-hydrants, 5 meters and 215 taps. Service pipes are of lead. The village pays $15 annually for the use of each hydrant. The daily consumption in 1883 was 75,000 gallons. The population in 1880 was 4,248, and is now said to be 7,500. R. C. Bacot is President, W. W. Shippen, Treasurer, and Chas. B. Brush, Chief Engineer and Superintendent.

DCCXL—HOBOKEN, N. J.

Hoboken, Hudson Co., New Jersey, in lat. 40°, 44′ N., long. 74°, 01′ W., is on low ground on the west bank of the Hudson, opposite New York City. Five-eights of the land within the city limits is salt marsh.

Settled in 1804, it was incorporated a city in 1855.

From 1857 to 1882 the city was supplied with water from the Jersey City Water-works. In the latter year new works were built by a private company after plans of John F. Ward, C. E., and under the direction of Chas. B. Brush, C. E., taking the supply from the Hackensack River 16 miles above Hoboken. The dam, storage reservoir, pumping engines and force main are as described in the history of the Hackensack Water-Works, No. DCCXXXIX. The distributing reservoir, supplying Hoboken, West Hoboken and Union Town is at Union Hill, two miles distant from and 150 feet above the former city, and is constructed in earth embankment, the bottom and inner slopes puddled, and the latter lined with brick laid in cement. It has a capacity of 15,000,000 gallons. From this reservoir two lines of cast-iron pipe of 16 and 12 inch diameter, respectively, conduct the water to the city.

Distribution is by 16.1 miles of cast-iron pipe of 12 to 6 inch diameter with 150 fire-hydrants, 107 meters and 3,500 taps. Lead is used for services. The city does not pay for fire service. The daily consumption in 1883 was 3,500,000 gallons, of which 500,000 gallons is metered. The company also furnishes water through meters to 76 consumers, and 9 fire hydrants along the line of the force main

The population in 1880 was 30,999. During the month of July, 1884, the water delivered at the distribution reservoir, had a very unpleasant taste and smell, and to counteract this, air is forced into the water at a pressure of 115 pounds. The oxygen thus liberated goes into solution in the water and renews its life. This process has been entirely successful. It was suggested by Prof. A. R. Leeds of the Stevens Institute. R. C. Bacot is President, W. W. Shippen, Treasurer, and Chas. B. Brush, Chief Engineer and Superintendent.

WATER.

THE Holly Manufacturing Co., of Lockport, N. Y., has removed its New York office to No. 44 Broadway, into elegant and commodious, ground-floor quarters.

ROOSEVELT & SON, 32 Pine St. New York, have taken the $450,000 Nashville water-works bonds at 102½ and interest. They have the privilege of anticipating the taking of the bonds at 104½ and interest.

THE Boston Water Board was in New York this week investigating the subject of pumping machinery for use in the new Boston high service. They want two engines, 10 and 15 millions capacity respectively.

THE Dean Bros., of Indianapolis, Ind., are at work on six pumps for Schmidt's Brewery, in Indianapolis; one large duplex pump for the water supply of the Michigan State Public School, at Coldwater, and 15 pumps for Illinois and Kentucky distilleries.

WATER AND TRANSPORTATION.—Transportation by water is naturally cheaper than by railroad, but yet the railroads seem to increase their tonnage, while water-borne freight is decreasing. Perhaps the explanation lies in the fact that the railroads which carry freight the cheapest have "watered their stock," and are thus able to compete successfully.—*Boston Advertiser.*

THE New York City Water Company has been incorporated by Charles Spear, James H. Gould, William Ebbitt, Charles Crary, Samuel Carpenter, Joseph L. Liscomb, Chester L. Williams, William A. Sweeny, and George F. Gregory. It is to bore or dig for water, establish storage places for it, and to conduct it through the city for power and fire-extinguishing purposes. Its capital is $3,000,000, divided into 30,000 shares of $100 each. The incorporators of the company are to be its Trustees for the first year of its existence.

THE city of Charleston in its corporate capacity, is about to undertake the driving of the deepest artesian well in the world. It will be driven in the main part of the city, and, as it is expected to furnish 4,000,000 gallons of water per day, it is calculated, with the two similar wells already down, to furnish a sufficient supply of water for the entire city for many years. The new well will be 2000 feet deep, will be at least six inches in diameter at the bottom, and is to be completed by next August.—*Exchange.*

COL. GEO. E. WARING has been giving to the City Councils of Savannah, Ga., the results of his observations on the sewerage of that city. He stated that to sewer the central park of the city, would cost about $80,000 and a 30 inch outlet sewer to Timber Landing Creek would cost $30,000 more. To include the remaining portion of the city in the drainage plan, would about double this estimate or make the cost of the entire system about $200,000. He proposed the Waring system with automatic flush tanks, and the possible use of the lifting of the sewage by pumping, so as to drain the lower part of Yamacraw.

THE water-works of Jackson, Tenn., were started on April 21st, pumping from six tube wells.

THE new pump at the St. Paul, Minn., Water-works was started on April 21, in the presence of the Mayor and other officials. It is practically a duplicate of the two 10,000,000 gallon pumps already in place. It is driven by a 600 horse-power turbine; and on the test furnished a fire pressure of 120 pounds.

THE Fire Commissioners of St. Paul, Minn., have been experimenting with artesian wells. These wells were sunk as a substitute for five 1,000 barrel cisterns ordered last fall by the City Council. The three wells are some 200, 230 and 211 ft. deep and all raise water 35 ft. above the general level of the West St. Paul flat. In testing them a steam fire engine attached its suction to the 6-inch well pipe, and with two lines of hose, 1⅛ inch nozzles and 65 lbs. steam pressures, the engine threw two streams 150 feet horizontally and 90 feet perpendicularly. The wells cost $550 each to sink, while the cisterns were to have cost $2,000 each.

MR. O. GUTHRIE, of Chicago, Ill., proposes to prevent the further contamination of the lake water by the city sewage, as follows:—He says there is no hope for relief as long as the overflow from the Desplaines is allowed to force the sewerage into the lake. He would prevent this by tapping the Desplaines 40 miles north of Chicago, by digging a canal from Allison's bridge in Northfield, Lake Co., to Lake Michigan a distance of 8½ miles. He would get rid of the remainder of the water by means of the Sag, to the Calumet River at Blue Island. He estimates the cost of the Northfield Canal at $50,000. He proposes other secondary conduits to the lake, to remove the drainage away from the present crib.

HAWKINSVILLE correspondence Macon *Telegraph* and *Messenger*: Judge Lawrence C. Ryan has placed in the river at this point a water-wheel that bids fair to revolutionize the mode of obtaining water power in this country. The wheel consists of a shaft about 30 feet long, with radial arms 4 feet in length; to each set of these arms are fastened three floats, each of plank 1 inch thick by 12 inches in width and 15 feet in length. These floats are hinged to the arms by the outer edges., One end of the shaft is fastened to the bank of the river, and the other upon which the floats are fastened is out in the river under the water and guyed by ropes to the bank. The current of water keeps the floats on the under side of the wheel pressed against the arms; while the floats on the upper side turn upon their hinges and present only their edges to the current, so that the water is continually pressing against the floats on one side, and passing through the floats on the other. The experiment has been demonstrated beyond doubt that by this device large mills may be run on our river without fear of hurt from freshets, and the ebb and flow of the tides may be converted into power to run any amount of machinery.

IN sinking a well tube in England, a short time since, the tube was carried too far down, thus passing the best water-bearing stratum and effectually shutting out the hoped for water supply. It was no consolation to those interested to know that the same thing had happened before to others. The question, however, was how, in the present instance, to remedy the evil. As the tube could not be raised, it was determined to bore holes in the tube from its interior at the level of the chief water-bearing stratum, which was of course, known. An apparatus in which two drills were employed was therefore designed. The machine had a vertical spindle, operated by the ordinary boring-rods, and on which were fixed two bevel-wheels, gearing into two other bevel-wheels on each of the horizontal drill arms. One of these latter wheels was keyed to the drill spindle, while the other was tapped and ran as a nut on the screwed end of the spindle. The number of teeth in the two sets of gear was so proportioned that at each revolution of the drill it was fed forward, the feed thus being constant. The gearing was contained in a cylinder having flat springs extending from its bottom edge, which held it in position and prevented it from rotating while the drills were being fed up to the work. The apparatus being lowered into position, the vertical spindle is rotated and works the drills. When the holes are through, the vertical spindle is rotated in the opposite direction, and the drills are thus withdrawn. By means of this machine 70 holes were cleverly drilled in the tube at a depth of nearly 300 feet from the surface, resulting in the full supply of water required.

ANCIENT WATER SUPPLY.—The reservoirs of the ancients were not inferior to those of the present time. The expertness of the ancient engineers is attested by the remains extant They certainly are not buried in the waters of the Lethe. The Pools of Solomon still continue to furnish water to Jerusalem. They are three in number. The upper is 160 feet above the middle one, the latter 248 feet above the lower. The first was supplied by pipes from springs, and when full emptied into the second, and that into the lower one. The water was used for irrigating Solomon's gardens and supplying his Temple, The lower pool held about 31,442,425 gallons, the middle about 12,289,912 and the upper one contained 13,778,772—a grand total of 58,511,109 gallons. These pools were solid rock and masonry,

lined with cement, and had steps leading to the bottom. One historian says that Nebuchadnezzar, wishing to brick the bottom of the Euphrates, which flowed through the center of Babylon, caused a reservoir forty miles square to be dug, so as to allow his masons a dry river bed. Another historian writes Nictocris, a daughter of Nebuchadnezzar, is said to have dug a reservoir 410 stadia in circumferance, lined with stone, for the waters of the Euphrates, in order that the river bed at Babylon should be dry, so that she could build piers for a bridge. A stadium being 625 feet, it would make this circumference forty miles. These two reservoirs may be the same, and this shows what discrepancies there are among writers.—*Building and Engineering Times.*

NEWS OF THE WEEK.

Miscellaneous.

Laid up for Appropriations.—The steamer *Patrol*, of the Mississippi River Commission, arrived at St. Louis on April 21st, bringing with it the launches, boats and engineering instruments lately used in the river surveys. John Evans, lately in charge of work done on the *Patrol*, will remain on duty at the U. S. Engineers' office in St. Louis until further orders.

International Exhibition at Budapest.—It is announced that an International Exhibition will shortly be held at Budapest. Nine thousand firms in different parts of Europe, have, we are informed, already applied for space in the ninety-eight buildings which will be erected. The Exhibition is estimated to cost about £200,000, and will cover an area of 300,000 square meters.

The Tallest Chimney in the world is that of the Townsley works at Port Dundas, near Glasgow, Scotland, which is built of brick and stone, and is 454 feet in height. It is circular in form. The highest stone chimney is octagonal in form, stands 381 feet in the air, and is located in Halifax, England. In Rouen, France, there is an iron chimney 279 feet high, which was riveted together and afterwards lifted into place with a crane.

Test for Presence of Lead in Enamels, &c.—A very rapid and handy mode of testing the enamel or tinning of cooking vessels, etc., for lead is recommended by M. Fordoz. The vessel is carefuly cleaned to remove all grease, etc. A drop of strong nitric acid is then placed on the enamel or tinning, and evaporated to dryness by gentle heat. The spot where the action of the acid has taken place is now wetted by a drop of solution of potassium iodide (5 parts iodide to 100 of water), when the presence of lead is at once shown by the formation of yellow lead iodide. Tin present in the enamel, etc., does not give a yellow spot when the potassium iodide is added, the stannic oxide formed by the nitric acid not being acted upon.

Forest Influence on Temperature.—As the result of a series of observations made at seventeen forest meteorological stations in Prussia, Professor Müttrich has arrived at certain definite conclusions respecting the influence of the forest on temperature, which may be stated as follows: 1. The forest exercised a positive influence on the temperature of the air; 2. The daily variations of temperature were lessened by the forest, and in summer more than in winter; 3. The influence of the leafy forest was in summer greater than that of the pine-forest, while in winter the tempering influence of the pine-forest preponderated over that of the disfoliaged forest. An attempt to determine the influence of the forest on the mean annual temperature led to no sure results.

Underground Wires.—Chicago is far ahead of New York in the work of removing the overhead telegraph nuisance, and it is likely that all the wires in the Garden City will soon be laid underground. The following figures approximate the miles of wire already placed beneath the streets of that city:

	Miles.
Bankers' & Merchants' Telegraph Co.	400
Postal Telegraph Company	180
Chicago Telephone Company	28
Western Indiana Railroad Company	50
City Fire-Alarm Telegraph	60
Total	718

As soon as possible the Western Union Company will add 500 miles to this, and the Baltimore & Ohio Company 250 miles. This will make a grand total of 1,468 miles.

Electric-light wires are rigidly confined to buildings and personal premises, and the companies are forbidden to suspend their wires on poles or otherwise.

The work of placing the fire-alarm system under ground is being pushed as fast as possible. It is expected that it will take ten years to complete the job and it will cost $500,000. Of this sum $50,000 will be spent annually, beginning with the central business section of the South side. The conduits are being constructed of a size and solidity which will insure their lasting. A mile and a half of these conduits have been completed so far.

Preparing for Cholera.—The Pennsylvania Company has ordered a sanitary inspection of all its buildings in New Jersey and their thorough purification, in view of the threatened epidemic of cholera.

N. Y. Elevated vs: London Underground Traffic.—Figures that are both big and interesting are found in comparing the passenger traffic of the London Underground and the New York Elevated railway systems. The amount of patronage bestowed, and the enormous growth of this patronage, may be fairly taken as the measure of public appreciation. In 1879 a total of 91,420,178 persons made use of the London Underground lines, while in 1884 the number had increased to 114,447,514; during the corresponding five years the New York Elevated roads showed an increase from 46,045,181 to 96,702,620. While London still remains a good distance ahead in the grand totals, as it does in population, the ratio of increase was largely in favor of the American metropolis: in other words, while the Underground showed an increase of 23,027,336 in five years, the Elevated had expanded its figures by 50,667,439, at which rate it will not take New York long to catch up with London.

A City Moving Down Hill.—From recent surveys it has been ascertained that the entire city of Virginia, Nev., has moved over thirty inches to the east since the big fire of 1875. The Maynard block, in Golden Hill, is known to be gradually sliding down in the direction of Gold Canon, and has moved nearly two feet since its erection. This movement is so gradual that it does not affect in any manner the safety of the building, as the ground to a depth of nearly 100 feet to the bed rock is known to be continually sliding. It is a well-known fact among practical miners that the ground on which Virginia City is built is what is termed a slide, and that it is necessary to sink nearly 100 feet before finding the natural bed rock. These slides are caused by the constant crumbling of the rocks on the mountain sides. The debris thus accumulated through incalculable ages is constantly gravitating downward, and in a few hundred thousand years what is known as the site of Virginia City will be nothing but barren bed rock.

Composition of Pittsburg Natural Gas.—Dr. George Hay, who had been appointed by the Natural Gas Commission to make an analysis of natural gas, submitted a report, which is given as follows:

	Per cent.
Carbonic acid	0.00
Heavy hydrocarbons (olefiant gas, etc.)	0.50
Carbonic oxide	1.00
Oxygen	1.30
Light carbureted hydrogen (marsh-gas)	95.20
Hydrogen	2.00
Nitrogen	0.00
	100.00
Specific gravity of dry gas	0.520
Specific gravity of wet gas	0.554

Dr. Hay stated to the commission that it was more economical to conduct gas at a low pressure. High-pressure pipes should be carried in the air or on the surface of the ground. Dr. Hay stated that natural gas exploded with from 9 to 14 volumes of air. Mr. Robert Young, of the Alleghany Gas-Works, was examined, and said that he had also made an analysis of natural gas, and that it corresponded with that made by Dr. Hay.

Contracting.

Nashville Sewers.—The City Engineer of Nashville, Tenn., invites bids for the construction of a main trunk sewer, from 5 feet 6 inches to 6 feet 6 inches internal diameter, with all excavation, manholes, connections, etc., complete; the sewer will run from Cumberland river to a point in Summer St.

Cement Works.—The Standard cement works of Mankato, Minn., has just made a contract with New York parties for 2,500,000 barrels of cement. It will require four years to fill the order. The cement will be used in the construction of the Croton river aqueduct. So says an *Exchange*.

Western Building.—Among the Western cities Chicago expended the most in new buildings last year, the sum aggregating $20,689,600. Minneapolis comes next with $7,621,000; St. Paul, $7,266,000; St. Louis, $6,764,791; Kansas City, $6,680,600; Omaha, $4,107,400; Detroit, $3,676,227, and Milwaukee, $3,063,531. None other reached $3,000,000.

Contracts for the permanent improvement of forty-four streets and alleys were awarded on April 21st, at Minneapolis, Min. the contractors being:

A. Jaicks, four contracts, aggregating $52,333; Olof Vider, eleven contracts, $138,606; J. V. McAdam & Co., six contracts, $104,995; James A. Lackley, three contracts, $40,440; George W. Wilson, three contracts, $25,354; J. B. Smith & Co., one contract, $28,885; R. F. Conway, four contracts, $22,489; J. & P. White, two contracts $9,210; James Conlin, one contract, $10,386; William Kinsella, two contracts, $3,795 James Kincade, one contract $5,650; A. J. McBean, one contract, $13,566; Lyman Labounty, one contract, $19,438; James McMahon, two contracts, $4,973; Basler & Lansing, one contract, $3,230.

This is a total of over $400,000 for some thirty miles of paving, curbing, and filling, with various materials.

A Kentucky College to be Built.—The Board of Trustees of the West Kentucky College, invite bids for the erection of this College at Mayfield, Ky.

The Laconia (N. H.) Car Company has contracted with the Burton Stock Car Company of Boston to build 100 cattle cars, to be completed in June. Work will begin at once. The car company has on hand all the passenger work that can be done this season.

The Dexterville Construction Company with a capital stock of $100,000 filed articles of association at Madison recently. The incorporators are George Hiles, James Hiles and F. P. Hiles. The object is to construct and equip railroads in Wisconsin. The place of business is at Dexterville, Wood county.

Articles of Incorporation were filed April 24 in the Weschester County Clerk's office at White Plains for a company to supply gas to the villages of Port Chester, Rye, Harrison, Mamaroneck, Larchmont, and New Rochelle at $2.50 per 1,000 feet. The capital stock is $400,000, divided into 40,000 shares, at $10 a share. The directors for the first year are Andrew E. Smythe, George Olney, and Walter L. Harben. They intend to commence work immediately.

St Louis Water Pipe.—The St Louis Board of Public Improvements on the 14th ult., received proposals for 800 tons of water-pipe. The bidders were the Camden Iron Works, of New Jersey $23,920; Cincinnati and Newport Iron Company, $25,806; Shickle, Harrison & Howard, $19,960. to whom the contarct was awarded, and the South St. Louis Foundry, $22,250. The city is expending $550,000 in extending the water-works system.

Phila. Sewers Let.—During the meeting of Councils' Committee on Surveys, April 21st, twenty-six bidders made proposals for the construction of sewers. The building of section 6 of the intersepting sewer for a distance of 800 linear feet through rock near the tunnel on the river drive was awarded to William Peoples at $14.38 per foot, with Moore & Co., the only bidders for 125 feet of the submerged outlet to the river near Fairmount. The following main sewers were coutracted for: Dauphin Street, near Twenty-fourth, F. P. Deeham, at $19.50 per foot; Sansom Street, Twenty-seventh Ward, M. O'Rourke, $49.99; and Lombard Street, from Seventh to Tenth, J. J. Kennedy, $21.99.

Constructing Large Marine Dredges.—A dredge o 600 tons is about being launched at the yard of Simons & Co., Renfrew, Scotland, destined for work in the harbor of Aberdeen. The dredging apparatus is 350 horse-power and can work to a depth of 32 feet. Two other dredges from the same company are now being tested on the Clyde. They made a speed of 9 knots, and after running at this speed the propellor was suddenly stopped and the bucket arm lowered to a depth of 39 feet with ease and great rapidity. These dredges have each two compound, surface condensing engines of 500 horse-power; the boilers are steel and carry steam at 80 pounds pressure. They are to be ultimately used in the port of Valencia.

New York's Harbor Channel has again to be improved, and the commission charged with the work recommends the construction of a stone dyke running about south-southeast from Coney Island to such distance as shall be found necessary, and probably not less than four miles; the protection of the head of Sandy Hook, and the dredging of a thirty-foot channel from deeper water near Sandy Hook to deep water below the Narrows; also the immediate dredging of a channel 1,000 feet wide and twenty-eight feet deep through the shoal West of Flynn's Knoll.

Major Gillespie, of the United States Engineers, after making a survey of Gedney's channel, through Sandy Hook bar, recommends the removal of 700,000 yards of material, giving a cut 30 feet deep at low water. The board agreeably to these suggestions estimates the cost of the work of clearing the main entrances to the sea at $5,000,000 to $6,000,000 and Congress is asked to make the necessary appropriations.

The Chattanooga Bridge.—The City Engineer of Chattanooga, has transmitted to the Board of Public Works and Affairs the following estimates for the approaches to the new bridge:

APRIL 25, 1885.—To the Board of Public Works and Affairs: As directed by you, I herewith transmit plan showing the proposed improvement of Woodland street, from the east end of Cumberland River Bridge to First street and vicinity, together with estimate of cost of same.

Exhibit A shows estimates for a street 60 feet in width from the bridge to First street, while exhibit B shows estimates for a street 60 feet in width at the bridge and widened at First street to about 104 feet.

Examination of these estimates indicates the cost of proposed improvement to be; Exhibit A, 60 feet street, $72,354.60 or $77,656.60; exhibit B, wide street, $91,402.60 or $100,304.60. Respectfully submitted,

EDWARD MEAD.
Eng'r Board Public Works and Affairs.

On April 25 the Board of Public Works and Affairs paid Messrs. Flannery & Holmes an installment of $5,000 for work done under the bridge contract. Up to date they have received $37,787.65.

Railroads, Bridges and Canals.

The Indian Government, will spend $17,500,000 yearly in the building of railways for the next six years.

Calabasas to Tucson.—A company has been formed to build a road to Calabasas, Arizona, to Tucson, thence north to Globe, with a branch to Phœnix via Florence.

The Richmond and Danville Railroad, will replace the Peachtree creek bridge with a magnificent iron structure. Contractors are already figuring on bids.

Iowa R. R. Mileage.—The returns to the Iowa Executive Council of the railroad mileage in the State show an increase during 1884 of 375 miles. The total mileage is 7,150.

The Atchison, Topeka & Sante Fe Railroad, company has placed a survey corps in the field to run a branch railroad line from Bernalillo, forty miles south of Sante Fe, to the James Hot Springs, a distance of twenty-five miles.

A Locomotive Speed Clock, a German invention, is in use on one of the Northern Pacific locomotives on the Rocky Mountain division. It indicates the exact speed at which the big machine is rushing over the trail.

Nova Scotia Railways.—Two representatives of an English company have arrived at Halifax, N. S., to submit an offer to the local Government for the amalgamation and completion of the Western railways of the Province.

Locomotives to be Painted Black.—General Manager Hudson, of the East Tennessee, Virginia & Georgia railroad, has issued an order to the effect that all the engines are to be painted black. This is done so that they can be kept cleaner.

The Cumberland Railroad Company was chartered on April 21 in a northwesterly direction through Cumberland, Putnam and White Counties, Tenn., to a point on the Cumberland River in Smith or Jackson Counties between Carthage and a point opposite Gainsboro, with a branch to connect with the Tennessee and Pacific Railroad, near Lebanon.

The St. Charles Bridge.—The engineering department of the Wabash has already begun the construction of the two fixed spans which will complete the new St. Charles bridge. The spans are each to be 300 feet in length and made of wrought-iron. The ironwork has been made by the same firm that did the work for the St. Louis bridge. About one-half of it is now on the ground; the spans will be finished in about six weeks.

Rome & Chatanooga R. R.—J. D. Williams, representing a syndicate of New York capitalists, submitted a proposition April 21st, to the stockholders of the Rome and Chatanooga railroad for the immediate construction of the line. The proposition was accepted and at once all the preferred stock was taken. The rights of way have been secured, and work will soon begin. The road will be sixty miles in length, and will pass through one of the richest mineral regions in North Georgia, between Chatanooga and Rome.

Galesburg, Lacon & Chicago R. R.—Articles of incorporation were filed on April 22d, of the Galesburg, Lacon & Chicago Railroad, with the principal business office at Chicago. It is proposed to construct the road from the City of Galesburg through the Counties of Knox, Peoria, Stark, and Marshall to Sparland or the City of Lacon, as the company may elect. The capital stock is to be $1,500,000. The incorporators and first Board of Directors are Charles Cleaver, Edwin C. Markham, Jonah S. Scovel, Edgar G. Barrett, and G. E. Hannon, all of Chicago.

Proposed Extension of the C. & C. Midland.—The most interesting railroad topic now discussed by the people effected, is the proposed extension of the Cincinnati and Columbus Midland. There are three prominent routes proposed, but there is no other which presents the merits offered by that which leaves the Midland at Washington, C. H., and passing either through Leesburg or Lexington to Hillsboro; thence to Sardinia and Maysville. The next route which has many advocates is for the extension to leave the Midland at Sabina, Clinton County, go to New Vienna, thence to Hillsboro, Sardinia and Maysville. The third and last route proposed leaves the Midland at the junction with the Cincinnati, Washington and Baltimore Road at Clinton Valley, going direct to Sardinia and Maysville, leaving Hillsboro out of its route.

New Wisconsin R. R.'s.—MADISON, Wis., April 21st. Articles of association of the following railway companies were filed to-day with the Secretary of State: Superior, Hayward and Southern Railway Company, which is to build a main line from the village of Superior by way of Hayward to Chippewa Falls, a distance of 141 miles; a branch line from Hayward to the Western boundary of the State, in town 14, range 16 west, 40 miles; another branch from Hayward to the northern State boundary line, in town 41, range 11 east, 120 miles; capital stock $2,000,000. The Grand Rapids, Centralia and Marshfield Railway Company, to build a line from Centralia, by way of Vesper and Marshfield, and through Marathon, Lincoln, and Forest Counties, to Lake Superior, a distance of 200 miles; capital stock, $500,000.

A Canadian Canal Scheme.—Mr. White (Renfrew) on April 21, made a good speech in advocacy of the long talked of scheme for connecting Montreal and Lake Superior by Canal, and the Ottawa and French rivers. In 1849 it was advocated by Lieut. Synge, and since then it has found many advocates.

Wisconsin Cent. Extension.—It is rumored that the Wisconsin Central is about to build a line from Green Bay to Sturgeon Bay, a distance of ninety miles. The belief that the Central has recently come into practical control of the Green Bay road, coupled with the fact that through connection from Sturgeon Bay with the East could be had by means of the Flint & Pere Marquette boats, lent credibility to the story. Manager Finney, however, when questioned on the subject, answered directly that he had not received any official information to the effect that a new line was projected, and added that he did not believe the story.

Electrical Headlight Makers.—The annual meeting of the stockholders of the American Electric Headlight Company was held at the Denison House, Indianapolis, on April 21. Said one of the directors to a *Journal* reporter, "We have passed the experimental stage and are ready to talk to our railroad friends. The plant we now use weighs about 400 pounds, and instead of running our engine 1,500 revolutions per minute we have reduced the speed to 600. We thought a year ago we would not be able to sell a full equipment for less than $800; our price now is $150. We now have patents covering nearly 300 claims in the United States, and control patents in seven foreign countries. The lamp we are now using is the invention of George Pyle, and is the only lamp ever made that is electrically governed, all springs, weights, dash pots, etc., having been dispensed with."

Working Old Steel Rails.—The Ironton *Register* (Ohio), says: "We alluded recently to the iron and steel mill experimenting upon the reduction of steel rails to billets by a new process. Heretofore it has been impossible to convert a rail into a billet without maintaining splits and crevices in the billet, which would, of course, reappear at every stage in succeeding manufacture from a tire to a wire. This was a fatal imperfection. Some parties in Ironton are the assignees of a patent obtained in England for special rolls to conduct this transformation and at the same time prevent the recurrence of the split in the rail. The experiments at the iron and steel mills succeeded admirably. Their billet is sound and solid, and horseshoes, tires, nails, rods, etc., made from it are perfect. They have at the mill numerous articles into which the old steel rail has been transformed, and many samples of their billets and manufactured steel rails have been sent to consumers for inspection."

Chicago & Indiana R. R.—Articles of association were filed April 23rd, in the office of the Secretary of State for the Chicago and Indiana Railway and Coal Company, and William Foster, Frederick Hoover, James Murdock, Isaac D. Dunn, Thomas Hanlon, Robert K. Abbott, and John D. Foresman are the directors named therein. The capital stock was fixed at $1,500,000, and is divided into 3,000 shares. The contemplated road extends from the city of Laporte southwardly through to a convenient point of junction with the Louisville, New-Albany and Chicago Railway, and thence southwardly to make connection with lines running south to the Ohio River; also with branches to any coal mines which the company are authorized to purchase, lease, or operate. The charter also contemplates branches through the country of Benton to the Illinois State Line, and thence by connections to Danville, in that State. The parties organizing the company intend to begin the work soon and prosecute it to a speedy completion.

The Pennsylvania Railroad Company has just filed with the chief engineer of the city of Philadelphia the mileage of the road owned or controlled by this great corporation. The following shows the length of tracks on all railroad lines owned, leased and controlled by the Pennsylvania Railroad Company, east and west of Pittsburg and Erie, on the 1st day of **January**, 1885:

	Main Lines.		Branches.	
All lines.	Miles of R. R.	Total Track.	Miles of R. R.	Total Track.
Penn. R. R.	2735.33	5245.79	1198.33	6858.61
Penn. Co.	848.66	1294.66	133.41	1450.20
Pitts., Cin. & St. L.	667.74	943.11	251.93	1242.32
Ch., St. L. & Pitts.	581.07	726.53	2.34	729.27
St. L., Van. & T. H.	167.55	213.55	2.25	218.60
G. Rapids & Ind.	452.19	525.69	61.58	595.17
Grand total miles.	5472.54	8949.13	1649.84	11094.18

Being an aggregate of 7,122 38-100 miles of railroad and 11,094 18-100 miles of track.

The lines owned, leased and controlled by the Pennsylvania Railroad Company, east of Pittsburg and Erie, run through the different States as follows: New York 101.50 miles; New Jersey, 708.85; Pennsylvania, 2,434.03; Deleware, 161.89; Maryland 412.05; District of Columbia, 8.17; Virginia, 92.37; West Virginia, 11.80. Total, 3,936.66.

West of Pittsburg and Erie—Pennsylvania, 243.12 miles; West Virginia, 35.15; Kentucky, 3.01; Ohio, 1,262.99; Indiana, 1,052.84; Illinois, 216.55; Michigan, 375.06 Total, 3,188.72.

The South Pennsylvania.—PHILADELPHIA, April 27th.—A special meeting of the Directors of the South Pennsylvania Railroad was held to-day. Robert H. Sayre, the President, said that the work on the road could be completed and the line equipped ready for operation for the amount already subscribed by promoters of the enterprise. He had, he said, inspected the road and was satisfied that it could be completed, as to grading and track-laying, by the time of the completion of its longest tunnel, which was to be finished July 1, 1886. The expenses of construction are met by monthly instalments of 5 per cent. on the amount subscribed—$15,000,000—of which William H. Vanderbilt has one-third.

Car Wheels.—Car wheels have long been a subject of toil and study with ambitious inventors. One company has devoted a great deal of time to experiments with steel, and is convinced that the car of the future will roll on wheels made from that metal. There are many reasons why steel car wheels are better than those of iron. They are lighter and will last much longer. Again, steel is three times stronger, and additional safety will be secured by using it in the manufacture of car wheels. An iron car wheel will travel about 40,000 miles. A steel tire will run fully 200,000 miles. Steel tires have been tested, and it is known just what can be expected of them. There is not a great difference in cost in the end. A wheel of solid steel will cost two and a half time as much as an iron wheel, but its life is more than four times as long.

England's Quetta Railway.—It is stated that the railway plant for the military line through the Bolan Pass to Quetta, which is to be at once commenced, has been to a great extent stored in India for some years. When the Quetta railway extension was originally projected rails and sleepers were collected for the purpose. Some miles of these rails were subsequently used elsewhere, but the store has lately been replenished by the dispatch of material from England. The hired transport Duke of Devonshire, on proceeding to Suakin with troops six weeks ago, took out many tons of flange rails, which, after debarking her troops, she conveyed to Bombay. Several ships going out to India within the last two months have had tonnage of metal rails, and it is understood that sufficient plant has now been collected for the construction of the projected line.—*London Times.*

Chicago, Nebraska, Kansas City & S. W. R. R.—The charter of the Chicago, Nebraska, Kansas City and Southwestern Railway Company was filed on April 22d with the Secretary of State. The purpose of the company is to construct, maintain and operate a railway and line of telegraph therewith, beginning at a point in Kansas, thence southward through the Counties of Rooks, Ellis, Kness and Hodgeman to or near the City of Dodge, in Ford County, with a branch from such point in Hodgeman County as may be deemed most desirable through the Counties of Ford, Edwards, Comanche and Barbour, to or near the City of Medicine Lodge, in said County of Barbour; and such other branches from such points in the State of Kansas as may from time to time be deemed desirable. The estimated length of such road and branches will be about 700 miles. The business of the company is to be conducted at Dodge City. The Board of Directors is composed of the following persons: S. A. Martin, Alexander Sears, J. C. Gilham, A. L. Stone and H. G. Jones, all of Eureka, Kan. The capital stock shall be $7,700,000, to be divided into shares of $100 each.

To Run on One Rail—At Rockaway Beach there is now on exhibition a working model of the Allen Elevated Railroad, invented by Norman Allen. He has invented a car propelled by a spring for a short distance route, and for long distances he uses a bycicle engine for motive power. The trains are run on an elevated double track, with only a single rail to each train. Between the two tracks is an upright frame surmounted by a double-grooved rail, on either side of which runs a wheel attached to the upper side of the car. The car wheels are mounted on swivels which enables them to round almost any curve. The propelling springs are placed in the center of the car and are calculated with one winding to drive it from one station to the next. Each station will obtain a small stationary engine, which, by cable attachment, will start the train and propel it for about 20 feet, during which time the springs will be rewound by a pinion attachment working in the teeth of a beam arm at the side of the track. The superstructure for the road is to be erected on a single line of posts made of 4-inch tubing. Among the benefits claimed for the invention are light running expenses, lack of noise and jar ability, to surmount heavy grades without additional weight on the tracks, and to round curves at a high rate of speed without increase of friction. The tracks for long distance roads are to be constructed the same as for the city roads. The bicycle engine will weigh less than ten tons, and is to be constructed with a 15-foot driving wheel running between the two boilers. The driving shaft works over the boilers. With a bicycle engine on an Allen track the inventor expects to cover the ground at the rate of two miles a minute. The uprights for the structure are supplied with a devise which enables them to be easily raised or lowered in case their foundations settle.—*New York Times.*

The Mexican National Road is progressing favorably. Work on the main line from the City of Mexico north will be completed to San Luis Potosi, 110 miles, in a few months. Work is also being done on the Pacific division from Morelia to Patzcuaro. When these two divisions are completed the company will finish building from San Luis Potosi to Saltillo, 246 miles.

German Railways.—For the extension and completion of the net work of German railroads, grants to the extent of 60,700,000 marks have been asked for. Of this sum 49,484,000 marks are required for the construction of fourteen new lines, of a total length of 865 miles, and the balance is needed for the completion of existing railroads.

The Massachusetts Roads.—BOSTON, April 23.—The complete report of the Railroad Commissioners for the year ending Sept. 30, 1884, will soon be ready for distribution. The report shows the development of the railroads of this State within the past five years, or from 1880 to 1884, inclusive as follows:

	1884.	1880.
Railroad mileage	4,958	4,149
Total stock	$127,668,390	$118,390,871
Net debt	74,439,473	59,172,520
Gross income	43,119,302	35,140,374
Net income	11,048,618	11,191,815
Percentage of gross income to permanent investment	20 4-10	19 5-10
Percentage of net income to permanent investment	5 2-10	6 2-10
Passengers carried	66,517,265	45,151,152
Tons of freight carried	20,273,920	17,221,567
Average fares	1 9-10 mills	2 2-10 mills
Employes	30,509	21,615

Capital in English Railways.—The amount of capital that has been absorbed by the English railways in the past five years is marvelous. The original share capital of nearly all the roads in that country was very large, but the increase makes them appear almost fabulous: The London & Northwestern increased its capital from £100 487,849 to £105,946,206, an increase of £5,458,327. The Great Western's capital is £74,410,525, an increase of £3,059,141; Midland, £76,549,266, an increase of £8,632,824; Northeastern, £60,769,708, an increase of £1,852,776; Lancashire & Yorkshire, £40,272,169, an increase of £3,983,114; Great Northern, £34,427,050, an increase of £1,509,000; Great Eastern, £39,128,118, an increase of £3,933,897; London & Southwestern, £28,769,153, an increase of £4,717,594; Southeastern, £26,226,954, an increase of £4,078,715; London & Brighton, £24,348,035, an increase of £1,911,425; Manchester, Sheffield & Lincolnshire, £28,719,558, an increase of £1,123,583; London, Chatham & Dover, £25,856,439, an increase of £1,122,570; Metropolitan, £13,806,543, an increase of £4,983,258; and Metropolitan District, £8,932,110, an increase of £3,087,666. The increase in capital of these fourteen roads is £49,643,920. One half of these roads are paying dividends of from 4 to 8 per cent. per annum, and with scarcely an exception all are realizing something to their stockholders.

A New System of Metallic Ties.—Mr. Thos. H. Gibbon, of Albany, N. Y., has devised a new system of ties and rail fastenings, which is described by a local paper as follows:

The object of the invention is to provide suitable appliances for building railway tracks, preventing spreading and creeping, and dispensing with the use of wooden ties, bolts, nuts and spikes. It consists of metallic ties connected together by laterial and transverse rods, mortised on the sides, at the middle and near each end; also sockets into which the rods drop. These rods thus become not only tie rods but an accurate track guage. The plate of the half shaped railroad chair passes through the mortises in the ties and under the rail and directly over the sockets into which the eye of the rod drops, thus making a secure lock to the tie rods, a bed for the rails to rest on and the usual railroad chair. A hook-like or inturned longitudinal flange runs along the entire length of the tie and is adapted to overlap the flange of the rail, thus giving most thorough and continuous support at the outer side of the track. A wedge driven longitudinally through the slot in the chair locks the tie and rails together. Mr. Gibbon estimates 1,400 to the mile, giving more surface bearing than 2,800 wood ties, which are now required—dispenses with spikes, the renewal of ties, and uses only half the quantity of ballast. Mr. Gibbon is about sending to England models of his automatic signal, which received the silver medal at Chicago; also his boltless rail joint fastener, which is now undergoing test in the railroads there, and also the metallic tie.

Index to Periodical Literature.

Railway, Metropolitan, Paris.—*Paris Metropolitan Railway Scheme.* A general outline of the project for constructing and working the Paris Metropolitan railway system. Eight plans are briefly, and the adopted plan more fully described, with the plan of each route. The railway is to be underground. The cost of construction, the probable traffic and the rates to be charged are given. *Engineering*, June 27, 1884, pp. 568, 574 and 575.

Sanitary Construction.—*Sanitary and Insanitary Houses.* A long description of two houses erected in the grounds of the Health Exhibition in London, illustrating the difference between a properly and an improperly constructed house. The article gives a resume of the latest and best practice in this matter. *Engineering.* Aug. 22, 1884, pp. 182 to 184.

Sewer-Ventilation and House-Sanitation.—The paper criticises the general method of ventilation, and the increasing nuisance arising therefrom, and suggests remedies. A paper read before the Society of Medical Officers of Health Kensington, by Wm. Weaver. *Sanitary World*, March 7, '85, pp. 299, 300.

Sluices, Drainage. *Sluices at the Lough Erne Drainage Works.* Description of a novel and very noteworthy set of sluices erected across the short river between Belleck and the Atlantic. The works are designed to improve the navigation of the chain of lakes having their outfall at Belleck, and at the same time to prevent the flooding of the up-country. These sluices perform the duty of a weir, by backing up the inland waters, but at the same time form no obstruction to floods, and do not give rise to any deposit of silt. The article is very fully illustrated with general views and details. *Engineering*, Sep. 19, 1884, pp. 268, 269 and 272.

Steel, Compressed. *L'Acier Comprimé.* A paper on the physical qualities of compressed steel, including a report on the subject by M. Carnot, and a discussion of the results of his investigations. *Moniteur Industriel.* Feb, 5, 1885, pp. 41 to 44.

Street Subways.—A design for a subway to carry small pipes and wires, consisting of a cast-iron trough with sides and bottom in one piece, or separate, laid in sections, and covered with a cast-iron plate, fitting snugly and easily removed and forming a series of trays carrying the pavement, so that when in place a uniform surface is obtained. The interior is suitably fitted up to support the wires, etc. Illustrated with two cuts. *Contract Journal* April 8, 1885, pp. 424, 425.

Train Resistance.—*On the Resistance of Locomotives and Trains.—The Efficiency of Locomotives and their Consumption of Water and Fuel.* A study of the sources of resistance and their amounts, with formulas for expressing the total resistance. The errors in some of the accepted formulas are pointed out. Also an account of a series of experiments with a view of determining the consumption of fuel on the locomotives of the Alsace-Lorraine R. Rs., accompanied by tables of results. Abstracts Inst. Civ. Eng., from the German of R. Frank. *Van Nostrands.* March, 1885, pp. 222 to 228.

Water, Flow.—*Experiment on the Flow of Water in a 48-Inch Pipe.* Amount of a series of experiments made upon the Boston Water Works, in which the value of the co-efficient C in the formula $V = C\sqrt{Ri}$ was determined. This result is compared with results obtained from other formulas of Prony, Eytelwein, D'Aubuisson, Weisback, Neville and others, which are from 35 to 45 per cent. too low. By F. P. Stearns, with discussion. *Trans. Am. Soc. Civil Engineers*, Jan. 1885, pp. 1 to 18.

Market Report of Engineering Materials.

New York, April 30, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles		2.c. @ 2.3c.
Tee		2.25c. @
Beams and channels		3.0c. @ 3.5c.
Tank		2.1c. @ 2.15c.
Shell		2½c. @ 2¾c
Special plates, Tank		2¾c. @ 3c.
WROUGHT-IRON PIPE, PITTSBURGH.		
Butt welded, black	Discount	50
" " galvanized	"	40
Lap welded black	"	50
" Galvanized	"	67½
Boiler tubes	"	60
RAILS.		
Steel (large lots at mill)		$27.00 @ 27.50
Old rails		16.50 @ 17.00
Oldrails, steel		16.50 @ 17.50
R. R. spikes		1.8 @ 1.9c
R. R. splice-plates		1.65c. @ 1.75c.
R. R. Track Bolts		2.6c. @ 3c.
Barb-wire fencing, galvanized		4¾c. @ 5¼c.
" " painted		3¾c. @ 4¼c.
Corrugated iron		
Nails		
Iron		2.25
Steel		2.35

METALS.

COPPER.		
Lake Superior		11¾ @
Other Brands		10¾ @ 11¼
LEAD.		
Com. Domestic		3.60 @ 3.70
Lead Pipe		.05¾
Tin-Lined Lead Pipe		.15
Sheet Lead		.06¾
ZINC.		
Sheet		5.00 @ 5.20

BRICK.

(Cargoes afloat)		
Haverstraw 1st	per M.	$5.75 @ 6.25
" 2nd	" "	5.62 @ 5.87
Fishkill		4.75 @ 5.50
Up-River		
Jerseys		5.25 @
Long Island		
" pale		
FRONTS.		
Croton red		14.00 @
" dark		14.00 @
" brown		12.00 @
Philadelphia pressed		22.50 @ 23.00
Trenton "		22.50 @ 23.00
Baltimore "		37.00 @ 41.00
Buff "		33.00 @ 35.00
Enameled English		65.00 @ 130.00
" American		85.00 @ 120.00
Fire brick		25.00 @ 40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs. per bbl		2.75 @ 2.90
K. B. & S. " "		2.85 @ 3.00
Burham " "		2.70 @ 2.85
Keene's fine " "		9.50 @ 9.75
" course " "		5.25 @ 5.75
Roman		2.75 @ 3.50
Langerdorfer German "		2.90 @ 2 65
Dyckerhoff, " "		2.60 @ 2.65
Stettiner " "		2.60 @ 2.65
Alsen, " "		2.55 @ 2.60
Fieve " "		2.40 @ 2.50
Saylor's American		2.15 @ 2.40
Windsor, Standard, Cable's Portland } U. S. C. Co.		1.00 @ 1.10
		1.35 @ 1.50
		2.15 @ 2.40
ROSENDALE cements		0.90 @ 1.10

LIME.

Rockland common	per bbl	1.00
" finishing	"	1.20
Glensfalls, common	"	.85
" finishing	"	1.05 @ 1.10
Kingston, ground		0.95

STONE.

Cargo rates at New York.

Amherst freestone, No. 1	per cub. ft.	0.90 @ 95
" " No. 2	"	0.75 @ 0.80
" " light drab	"	0.80 @ 0.95
Berlin " in rough	"	0.75 @ 1.00
Berea "	"	0.75 @ 1.00
Brownstone, Portland, Ct.	"	1.00 @ 1.30
" Belleville, N. J.	"	0.75 @ 1.25
Granite, rough		0.60 @ 1.25
Common building stone per load		2.00 @ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.		0.40 @ 3.00

SLATE.

Purple roofing	per square	6.00 @ 7.00
Green	"	6.00 @ 7.00
Red	"	15.00
Black Penna. (at New York)	"	4.50 @ 5.00

LUMBER.

PINE, Common box	per M.	18.00 @ 20.00
Good	"	
Tally plank, 1½ in	each.	.44 @ .50
Tally boards, dressed com.	"	.28 @ .30
SPRUCE, Boards dressed	"	.25 @ .28
Plank, 1¼ in	"	.38 @ .30
" 2 in.	"	.38 @ .40
" 2 in. dressed	"	.43 @ .45
Timber	per M.	20.00 @ 22.00
HEMLOCK, Boards	each.	.18 @ .20
Joist, 2½ × 4 to 4 × 6 in		.17 @ .44
OAK	per M.	55.00 @ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in	"	35.00 @ 40.00
YELLOW PINE, Girders	"	26.00 @ 35.00
Dressed flooring	"	30.00 @ 40.00
SHINGLES, Extra shaved pine, 16in.	"	
" sawed 18 in.	"	4.50 @ 5.00
LATH, Cargo rate	"	2.40 @ 2.50

PAINT.

Lead, white, American dry	per lb	.04¾ @ .05
" " in oil pure	"	.05½ @ .05¾
English, B. B. in oil	"	.08½ @ .08¾
Red, American	"	.05¼ @ .05½
Litharge	"	.05 @ .05¼
Venetian red, American	"	.01 @ .01¼
Indian red	"	.05 @ .10
Vermillion, American lead	"	.11 @ .11½
Paris green	"	.15 @ .19
Umber, Amer. raw and powdered	per lb.	.01¼ @ .01½
Drop black, Amer.		.08 @ .12
" " "		.09 @ .11½
Chrome green		.05 @ .15
Oxide zinc, American		.03¼ @ .04
" French		.06¼ @ .06½

Electric Headlights.—Thirty-five passenger engines on the Vandalia main line are to be equipped at once with the American electric locomotive headlight. After a thorough test, Col. Hill, general superintendent, and George Prescott, superintendent of motive power, have become fully convinced that this is the coming light for locomotive headlights. The Vandalia will be the first road in this country to adopt this light so generally.